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Conducted by MAJOR B. BADEN-POWELL, F.R.A.S., F.R.Met.Soc., and E. S. GREW, M.A.

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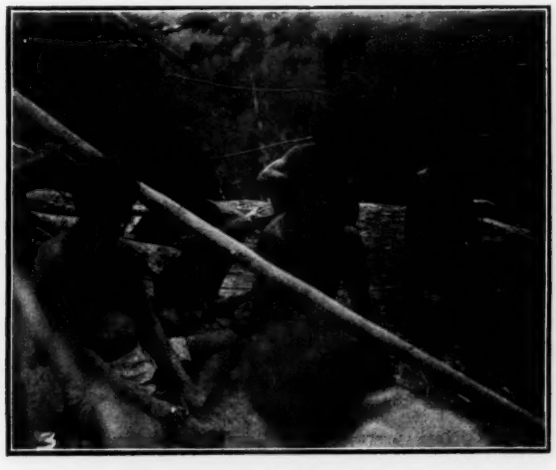
The Veddas of Ceylon.

THE fast disappearing primitive people of Ceylon, known as the Veddas, have recently received study—as regards their sociology and religion—at the hands of Dr. C. G. Seligmann, who, aided by a grant from the Ceylon Government, was enabled to sojourn among these folk for five months, and thus conduct researches whilst in actual conduct with their daily life and avocations. Dr. Seligmann was accompanied by his wife, and this circumstance had an important bearing on the concentration and issues of the investigatory work. Dr. A. C. Haddon, F.R.S., the well-known anthropologist, has laid special stress upon this co-operation. In his opinion it is no exaggeration to say that had not Mrs. Seligmann accompanied her husband the results would have been less numerous and important. Information obtained by men, through men, about the practices and ideas of native women must necessarily be imperfect and biassed. But in the present case the visitors were allowed to take up quarters close to the Vedda caves, and the presence of a woman led to an unbending and interchange of confidences which materially facilitated the objects of the expedition. By means of the phonograph (whose performances were received with huge delight, it seems) many songs and lullabies of the Vedda men and women were obtained, and here again Mrs. Seligmann's assistance was invaluable.



Danigala Veddas.

A generation ago the purest-blooded community in the Island. They now intermarry with Sinhalese.

It has been found convenient on sociological grounds to discuss the Veddas as members of three groups, namely, Veddas, and village and coast Veddas. The first group is made up of the minority of the still surviving members of the Vedda race. These form a number of communities varying in purity of blood, and the extent to which the habits and customs of their members have been modified by outside influence. All, however, have prevailing customs of a common origin, but not derived from Sinhalese or Tamil sources. In the Eastern Province, near Nuwaragala, Dr. Seligmann found a community consisting of four families whose members lived by hunting and on honey, yams, and other jungle produce. On the other hand, the present generation of the Danigala Veddas, the last of the Nilgala communities, now breed cattle and have extensive cultivable plots or "chenas." Moreover, most of their old beliefs are obliterated, and they wear Sinhalese garments whenever they are not on "show" to white people.

Two Veddas with much admixture of Sinhalese blood. In spite of this they still hunt to some extent.

As regards the village Veddas and coast Veddas, these groups have become so modified by contact and mixture with other races that they do not afford a really favourable field for the study of primitive characteristics. The present community of Dambani, in the jungle between Kallodi and Alutnuwara, are cited as an example of a village Vedda community. Some twenty families, living in tolerably built houses, keep buffaloes and cultivate chenas. A short visit was sufficient to

show that here were jungle folk who still retained many Vedda beliefs and were sufficiently strong and independent for there to be no likelihood of immediate fusion with the surrounding populations. Physically,

A Vedda Cave Scene.
Caves, if small, are the property of a single family; or, if large enough, may hold several families.

this community, though somewhat darker and often of a stouter build than, say, the Danigala Veddas alluded to above, could not be mistaken for Sinhalese.

The coast Veddas live in scattered villages, for the most part north of Batticaloa. They have much Tamil

A Vedda Rock Shelter.
Two natives will be noticed in the foreground under the rock.

blood in their veins, and, though often taller than pure Veddas, still retain an appearance which suggests their Vedda origin, this being more marked in the males than in the females. They have taken to fishing, and make and use a cast net. They also shoot fish, using the usual Vedda bow, but the arrow has become a harpoon with a shaft as long as the bow and a detachable barbed head. This, however, does not appear to have come from the Tamil, since they have no bows.

The majority of the communities of Veddas, while frequenting their chenas for part of the year, or even living on them altogether, still visit caves or wander about the jungle during the honey-gathering season. Dr. Seligmann has gathered many interesting facts respecting these features of life. Just as each family, he tells us, keeps rigidly to its own house on a chena, so caves, if small, are the property of a single family, or if large enough to hold several families, each family has a piece of cave floor on which to sleep, cook, squat, and keep its possessions, and each man and woman keeps as strictly to his or her portion of the caves as if it were fenced in. Beside hunting land and pools and stretches of river, places where any member of a community might hunt and fish, there were also areas of land within the communal land which, in a limited sense, were the property of individuals. There was also a similar limited right of private property in rocks and cliffs known to be the haunt of the rock-bee.

Veddas Drilling Fire.

On the psychical side the life of this folk is unusually limited in every aspect, except one, namely, their regard for the dead, and even this regard, which attains the intensity of a cult, has given rise to no decorative art; indeed, a number of crude drawings, for the most part of animals and men, executed on the walls of certain caves, were the only examples of decorative art seen by Dr. Seligmann. Personal adornment is at the lowest ebb.

Finally, a word or two should be added in reference to death ceremonies. According to most Veddas the spirit of every dead man, woman, or child becomes a "yaka" within a few days of death. The yakas of the recent dead are supposed to stand towards the surviving members of the group in the light of friends and relatives, who, if well treated, will continue favours to their survivors. Hence it is generally considered necessary to present an offering to the newly dead within a week or two of death, which must consist of cooked rice and cocoanut milk. This and other attendant customs were exhaustively studied and recorded as a basis for discussion in the future. Our photographs are reproduced by kind permission of Dr. Seligmann.

T. E. J.

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The Causes of Chemical Change.

By R. G. DURRANT.

"NEVER Mind the Why and Wherefore" is a motto we have heard in comic opera; if we also regard "opera naturæ" as a farce we may be content to take things as they come and ask no questions. But the average "homo" is an inquisitive creature—he likes to get at the back of things, or to think he is getting there, which pleases him just as well.

In the good old days of black magic every sage was secretive, he resented intrusion and was careful to shroud his researches in hieroglyphics not understanded of the people.

The result was disastrous in more senses than one, since he himself became an object of distrust while he lived, and his work was often relegated to oblivion when he died.

Things are changed in these days of blatant advertisement—those proverbial "farthing rushlights" are flaunted by the side of flaming torches, and everybody, though constantly blinking, shouts for more light.

And what has the conflagration revealed to those whose eyes are not blinded?

It has shown just the glimpse of a great tree whose roots are buried in the earth and whose branches are lost to view in the distance above.

The simile is old—the "Tree of Knowledge"—the "Why and Wherefore."

Advertisement has its uses, and although somebody's Fruit Salt may not be such a Summum Bonum as the pictured Sage professes it to be, still it is mildly beneficial, and Englishmen at least can hardly be ignorant of its existence.

The Age is also one of journals—those pigeon-holes of formulated thought. We look at headings, glance over some article, and if we like it or feel we want it, we try to transfer part of it to our private brain store; but, then, storage accommodation in most brains is limited, and the owner is forced to be judicious in what he selects.

There are very few who would dare to repeat (in whispered reference to their brains):

> "I am Master of this College,
> What I know not is not knowledge."

So it comes about that we specialise and, like shopkeepers, fill up our brain-emporia with selected goods of limited variety.

The present writer has before him a warehouse of specialities contained in fifty-nine bound volumes of the "Journal of the Chemical Society," and open in front of him is the Presidential Address for 1908. On the first page of that address Sir William Ramsay says: "Chemists and physicists deal with the world of phenomena, with operations and results of operations which take place in what is called 'Nature,' that is, in the region exterior to the minds of the observers. They have agreed implicitly to avoid the consideration of the relationship between such phenomena and the mind of man, a branch of the subject termed Metaphysics; they confine their attention exclusively to the relationships which they observe to exist between various phenomena external to the workings of consciousness."

I have chosen for my subject "The Causes of Chemical Change," and I should be wanting both in obedience and loyalty to the President of my Society if I departed from his injunctions—if I mixed up facts with feelings or substituted fancies for "the results of operations." And yet I have set myself to expound a subject about which there is much speculation. Nothing I might say could amount to more than suppositions, and these, as Dr. Johnstone Stoney says, are of three kinds—Theories, Hypotheses, and Fictions.

"A theory means a supposition which we hope to be true; a hypothesis is a supposition which we expect to be useful. Fictions belong to the realm of art; when allowed to intrude elsewhere they become either Make-believes or Mistakes."

The Greek philosophers had views on many subjects, and, among them, views on the nature of matter. Their theories on matter we may regard as artistic guesses, often ingenious and sometimes inspired; their arguments were largely drawn from analogies dealing with human intercourse, and so it came about that materials which appeared to exert activity were credited also with passions. The heritage of Greek speculation was handed down, through the alchemists, to comparatively modern times. Thus we find the Honourable Robert Boyle, a founder of the Royal Society, author of "The Sceptical Chymist," and seventh son of the Earl of Cork, writing as follows:—

"I look upon amity and enmity as affections of intelligent beings, and I have not yet found it explained by any how these appetites can be placed in bodies inanimate and devoid of knowledge or of so much as sense."

The "Sceptical Chymist" did much to clear the atmosphere of those suppositions which Dr. Johnstone Stoney would class as "make-believes," and yet how natural they are to the infant mind!

Boyle was a contemporary of Newton, whose mighty intellect ranged from stars to atoms.

Not only did he expound the laws of motion, discover gravitation, and dissect light with his prism, he also foresaw the difficulties which must beset the problem of Chemical Change.

"Have not the small Particles of Bodies certain Powers, Virtues, or Forces, by which they act at a distance. . . upon one another for producing a great part of the Phænomena of Nature? For it's well known that Bodies act upon one another by the Attractions of Gravity, Magnetism, and Electricity, and these Instances show the Tenor and Course of Nature, and make it not improbable but that there may be more attractive Powers than these. . . How these Attractions may be performed I do not here consider. What I call Attraction may be performed by impulse, or by some other means unknown to me.

"I use that Word here to signify only in general any Force by which bodies tend towards one another, whatsoever be the Cause. For we must learn from the Phænomena of Nature what Bodies attract one another, and what are the Laws and Properties of the Attraction, before we enquire the Cause by which the Attraction is perform'd."

Newton published these words in 1701 in the thirty-first query attached to the third chapter of his book on "Opticks."

It was not till near the close of the eighteenth century that the great discovery of oxygen by Priestley and the demonstration by Cavendish of the composite character of water opened up fields for more definite investigation.

But guesses were already becoming less vague. The famous German chemist, Becher, formulated, while Professor Stahl expanded, the theory known as that of Phlogiston. This was accepted in the latter half of the eighteenth century because it served to explain not only

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the way in which metals are procured from their "calces" or ores, but also seemed to account for such processes as burning and rusting. Phlogiston, the "fiery principle," existed more or less in all material and could pass from one kind of material to another, transforming both; when a body burst into flame then one saw the phlogiston escaping. Thus coal, when it burns, parts with its phlogiston, but when coal is heated with iron ore it transfers its phlogiston and we get iron as a metal, and so, speaking generally, chemical changes result from the visits and leavetakings of phlogiston.

Lavoisier demolished the theory by his experiments on combustion; he showed that such changes as the rusting or reducing of iron resulted from the visits or leavetakings, not of phlogiston, but of the recently discovered element oxygen. He showed that iron, when it rusts, gains in mass because of the added material of the oxygen, and that rust, when reduced to iron, loses mass since oxygen is removed in this process.

The advocates of the phlogistic theory were then driven to postulate that the more phlogiston you introduce into a body the lighter that body becomes, but this newly made assumption was so evidently a "make-believe" that nobody believed it. And yet there was more than a glimmer of truth in the theory, for the gains or losses in these chemical changes were gains or losses in energy, and if we substitute the word "energy" for "phlogiston" we may still accept the theory.

Lavoisier's work revolutionised chemistry, but he, unhappily for the world, suffered death during the great revolution of his country—he was guillotined by Robespierre in 1794. Writing some sixty years later, M. Würtz, in the Introductory Discourse of his "Dictionaire de Chemie," opens with two short sentences: "Chemistry is a French science. It was founded by Lavoisier of immortal memory."

The "History of Chemical Theories and Laws," recently brought out by Mr. Pattison Muir, is dedicated "To the Memory of The Master, Antoine Laurent Lavoisier."

Scientific progress in France was checked for a time, but meantime Galvani and Volta, in Italy, had given us the electric battery, and Davy, in England, used it to some purpose when, in 1808, he broke up the so-called elements potash and soda. The new metals he extracted were most remarkable, since they floated on water while they drove hydrogen out of it.

The age of electricity opened suddenly and brilliantly. Davy himself propounded a new theory in which chemical attraction depended on electrical changes. He accepted the theory of atoms published by Dalton in 1803, and conceived the reason why these atoms join together was because they were charged with opposite kinds of electricity.

It has been said, with much truth, that Davy's greatest discovery was Faraday. It might be added that his subsequent treatment of this discovery was the one unhappy blot on his own illustrious fame. Faraday, like Newton, remains a beacon to shed light through the fog which still surrounds us. He discovered many important facts concerning electricity when at rest, and he revealed many laws concerning electricity when it moves through material. To Faraday we owe the name and notion of "ions," those charged portions of matter which move invisibly and which only concentrate and become manifest when they are discharged.

Dalton's very definite conception of atoms has proved so fruitful that chemistry may be now defined as the study of atomic structures, of their relative stability and importance. The theory has opened out boundless fields for research, and scattered over various allotments there are now many thousand investigators. Twenty years ago these investigators were content for the most part to pull down structures ready made by Nature and to build up the same or different structures with these atomic bricks. Now it is only necessary to open any recent number of the Chemical Journal in order to discern the trend of modern research. The question now is not so much of the bricks as of the cement—of that which comes between the atoms. To requote: "We must learn from the Phænomena of Nature what Bodies attract one another and what are the Laws and Properties of the Attraction before we enquire the Cause by which the Attraction is perform'd." It would seem that two hundred years of labour—by far the greater part of it within the last fifty years—has thrown sufficient light on "the Laws and Properties of Attraction" to enable chemists to start on the enquiry of "the Cause by which the Attraction is perform'd." And this is Newton's prophecy. He says: "Nature will be very conformable to herself and very simple, performing all the greater Motions of the Heavenly Bodies by the Attraction of Gravity which intercedes these Bodies, and almost all the small ones of their Particles by some other attractive and repelling Powers which intercede the Particles."

A retrospect would seem to show that there are laws not only to govern the workings of Nature, but also to determine the "times and seasons" when these shall be unfolded to appointed minds. Looking backward to 1600 A.D. when Gilbert, having invented the mariner's compass, discovered that the earth itself is a magnet; then onward to 1700 dominated by Newton; then to 1800 a central point of epoch-making discovery, we come "per saltum" to 1900 and find ourselves living with discoverers yet more numerous, while future history will affirm them to be not less brilliant than those who came before.

In the intervals between these culminating points there have been steady work and many meteoric flashes of genius.

During the last half century it may be said that an army of architects has been occupied in learning the possibilities of atomic structures, while another army of engineers has been engaged in testing the value and transformations of physical forces. These armies, until recently, have worked independently, while their achievements have been chronicled in language which could only be thoroughly grasped by the minds of their several units.

A corps of interpreters was wanted, and such a corps is now in the process of training. Officers in both armies, and in the corps of interpreters, rise by merit from the ranks. We are very lucky in possessing several who may be regarded as generals, men who can both handle their own work and also marshal the results of other workers. Let us see what the engineers have been doing. Following up the pioneer work of Rumford, Joule, and others, they have established a great fundamental principle—that energy, through all its metamorphoses, is immortal; they have shown that light is but one of the many manifestations of electro-magnetic radiation, and that all such radiation is propagated through space with the same velocity—so that our wireless messages, like heat and light, travel at the rate of one hundred and eighty thousand miles per second. From the study of electro-magnetic radiation they have deduced many properties of that mysterious

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and responsive medium which is called "æther." Lastly they have demonstrated the existence of the electron, that sub-atomic unit of material.

And if, in very truth, the electron is material, it might be argued that it should be handed over to the chemists, especially since Madame Curie, the queen of lady chemists, has presented the physicists with a splendid field for research in the shape of radio-activity, but as the two armies have joined forces and find themselves in the same country, radio-activity is considered joint property, while the electron, whether at rest or careering about, is under joint inspection.

Let us now see what bearing these discoveries of the physicists have on our conception of atoms.

In the first place we must give up the notion of solid, stolid particles endowed with tentacles or hooks, and conceive in their place systems—sub-universes—of whirling electrons. The spaces between these electrons must be enormous as compared with the spaces occupied by the electrons themselves, and this intro-space must be filled with the same mysterious medium—æther—which separates the planets from the sun, and the stars from the solar system. Æther, therefore, to use Newton's language, "intercedes" atoms; they exist within æther and æther exists within them. Again we have strong reasons for believing that bodies are not made up of stationary atomic systems, but that these systems themselves are moving—slowly in solids, faster in liquids, and very fast in gases.

It has been found that radio-activity is not sensibly affected by heating or cooling, and, generally, that no "sub atomic" change has as yet been brought about through man's direct agency. On the other hand, we know that heat can cause atoms to separate, and, in many cases (so the spectroscope informs us), these atoms can be heated sufficiently to emit rhythmical vibrations producing definite kinds of light.

(*To be continued.*)

The Stars of the Year.—We have no hesitation in recommending to all lovers of Nature study the charming companion to the heavens, which has been compiled by "H. P. H.," under the name of "The Stars of the Year" (1s. net), and which is published by Messrs. King, Sell and Olding, Ltd., from the offices of "KNOWLEDGE." The little book, daintily bound in paper cover, comprises twelve clearly-printed Star Charts representing the principal constellations as they appear about the middle of each month, and the charts are prefaced by a workmanlike introduction characterising the chief features of the night sky. Another publication from the same source is "The Star Almanac for 1909" (3d. net), which, besides giving the usual information regarding the movements of the heavenly bodies day by day, comprises four star charts: spring, summer, autumn, and winter; portraits of Sir William and Lady Huggins, besides other illustrations and useful information.

Science Progress.—The October number of "Science Progress" (London: John Murray; 5s. net) maintains the high level which previous contributors and previous contributions have imposed on it. Mr. A. T. Cameran continues his series of articles on the vexed question of the "Transformation of Elements," dealing specially with Sir W. Ramsay's experiments on the formation of helium during radioactive changes. Mr. Lydekker furnishes a deeply interesting review of Mr. C. W. Beebe's experiments on the "Artificial Modifications of the Colouring of Birds." The number begins with a summary by Mr. Beach Thomas of the discussions on Darwinism and Mendel's theories at Dublin, and this review is succeeded by an article read before the Mendelian Society by Mr. J. T. Cunningham, on the Evolution of Man. Other articles of considerable scientific value are those by Dr. Martin Lowry, on the "Present Position of the Hydrate Theory of Solutions"; by Dr. Sollas on "Palæolithic Races"; and by Mr. F. Hatch, on the "Classification of the Plutonic Rocks."

A Study of Splashes.*

THE photographs which Mr. A. M. Worthington, F.R.S., has made from time to time of the splashes of falling drops of liquid, as well as of small solid spheres, are well known; and by many are regarded as mere curiosities of intelligent photography. But the publication by him of "A Study of Splashes," in which several series of photographs are collated, and the results ob-

Fig. 1.

Fig. 2.

tained from them explained, serves to relate the photographs one to the other and to show the lessons to be gathered from them. The frontispiece of the book is a reproduction of two photographs which show the effect of the impact of a projectile on armour-plate. The metal has sprung up and flown round the orifice formed in the plate by the projectile in very much the

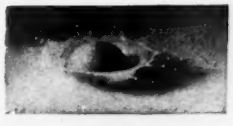

Fig. 3.

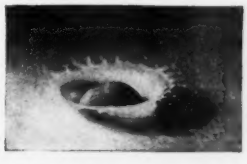

Fig. 4.

same way that a liquid rises about a solid body dropped into it. From these considerations it is possible that some information may in the future be derived concerning the phenomena of movement of viscous solids or of solids which are made to assume, under circumstances of great heat and pressure, the properties of fluids; and to deduce information about the distribution

Fig 5.

Fig. 6.

of internal stress in solids and liquids, such as may lead to improvements in armour plate. But the information more immediately obtained from Professor Worthington's photographs is concerned with the movements of liquids. When a rough, or greasy, or dusty sphere falls into a liquid, the liquid is forced away from it (Fig. 3). If the sphere is quite smooth

* "A Study in Splashes," by A. M. Worthington, C.B., M.A., F.R.S., Headmaster and Professor of Physics at the Royal Naval Engineering College, Devonport, with 197 illustrations from instantaneous photographs. (London: Longmans Green, 1908, 6s. 6d. net.)

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the liquid rises up around it enclosing it in a sheath. Why does the rough sphere make one kind of splash, the smooth sphere another kind? This is one of the questions which the experiments enable the investigators to answer; and they also suggest certain conclusions concerning the movements of liquids under the combined forces of inertia and of surface tension.

We reproduce, by permission of Messrs. Longmans

Fig. 7.

Green, a series of photographs, showing successive stages in the entry of a rough sphere into milk and water, and the resultant "basket splash." The diameter of the sphere was about 1.5 c.m. (or $\frac{3}{5}$ inch), and the height of the fall about 15 c.m. (or 6 inches). Examination of the photographs shows that the liquid, instead of flowing over and wetting the surface of the sphere, is driven violently away, so that as far as can

Fig. 8.

be seen from above, the upper portion is, at first, at any rate, unwetted by the liquid. The gradual thickening of the crater wall and the corresponding reduction in the number of its lobes as the subsidence proceeds is beautifully shown. Thereafter there rises from the depth of the crater an exquisite jet (Fig. 7), which in obedience to the law of segmentation at once splits up in its upper portion into little drops, while at the same time it gathers volume from below and rises ultimately as a tall graceful column to a height which may be even greater than that from which the sphere fell. In a further series of photographs, which depict

Fig. 9.

the subsequent movements of the sphere below the surface of the liquid, Professor Worthington shows quite clearly the causes which give rise to this emergent jet.

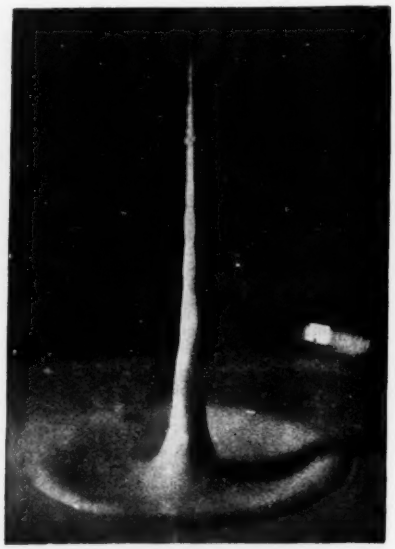

Fig. 10.

The photographs and the explanations which accompany them make up a contribution to the science of liquid movements of the greatest value and interest.

IN the belief that our knowledge of comets may be considerably enlarged through a proper use of the opportunities presented by the approaching return of Halley's comet and the systematic observation of such other cometary phenomena as may be presented during the next few years, the Astronomical and Astrophysical Society of America has appointed a committee upon comets, consisting of Professors George C. Comstock, chairman; Edward E. Barnard; Charles D. Perrine; and Edward C. Pickering. It is the purpose of this committee to canvass the whole field of cometary research, inquiring what parts of that field will best repay systematic cultivation at the present time, and securing, so far as possible, co-operation in such research.

Ancient and Popular Ideas of Comets.

By IRENE E. TOYE WARNER.

A COMET with historical associations of very interesting character is expected to return to the sun in 1910. It may, therefore, be of some service to give a few ancient and popular ideas as to the nature and supposed mission of these mysterious visitors from the boundless realms of space. It is strange that in the Middle Ages many erroneous ideas were prevalent, especially as the Chaldeans, according to some authorities, were practically modern and correct in their views, their belief being that comets, like planets, move in regular courses, and are invisible at times, owing to their recession from the sun and earth, and that their periods may be known by observation. Seneca also held these opinions, but he was in the minority, as is too often the case with those who are in advance of their Age.

The great philosopher, Aristotle, whose writings on many subjects held supreme sway over the civilised portion of the world until the Middle Ages, believed that the heavens were incorruptible and unchangeable, and that comets could not be reckoned as belonging to the heavenly bodies, but that they were only exhalations raised into the upper regions of the air, where they blazed for a time and then were entirely destroyed as soon as they ceased to be visible. Other ancient ideas are equally wide of the truth. Amongst many that could be mentioned are those of: Metrodorus, who thought they were "reflections from the sun"; Democritus, "a concourse of several stars"; Strabo, "the splendour of a star enveloped in a cloud"; Heracletes of Pontus, "an elevated cloud which gave out much light"; Epigenes, "some terrestrial matter that had caught fire and was agitated by the wind"; Anaxagoras, "sparks from the elementary fire"; and Xenophanes, "a motion and spreading out of clouds which caught fire." They were also considered wandering stars (the word "comet" literally means a "hairy star") and meteors, having a purely atmospheric origin.

There are a few allegorical descriptions in the New Testament which imply that the Biblical writers had noticed and knew something about comets. St. Jude speaks of "*wandering stars* for whom the blackness of darkness hath been reserved for ever"; and in Revelation we read, "there fell from heaven a great star, *burning as a torch*"; this expression is frequently used to describe a comet in ancient MSS. Perhaps the very vivid description of the dragon in Revelation served as a type to later writers, who possibly thought that the dire prophecies were being fulfilled by the apparitions they so much dreaded, and thus, in terror, they beheld in the sky the pictures they had conjured up in their imagination and invested with such awful portent. By comparing the account in Revelation with the descriptions of comets which appeared in the Middle Ages we are at once struck with the resemblance. The picture in the sacred Book is as follows:—"There was seen another *sign* in heaven; and behold, a great red dragon, having seven heads and ten horns, and upon his heads seven diadems. And *his tail draweth the third part of the stars of heaven.*"

With the acceptance of the Copernican conception of the Solar System, that is, the central and controlling position of the sun, man was taught the true and subordinate position of the earth in the Universe. This was a blow to his pride, for whilst the Ptolemaic ideas held sway, the earth was regarded as of primary importance, and the whole heavens and the glory of them as merely created for the benefit of her inhabitants. Possibly it was as much for this very human reason as for a mistaken notion of the teaching of the Scriptures that the Copernican theories did not gain ground very rapidly. It is little wonder, then, that such an apparition as that of an unknown "blazing" star was beheld with awe, and more often dismay, as presaging evil to some potenate or a great calamity to the nations; but sometimes, happily, the idea of its baleful influence gave way to a more healthy feeling, and the comet was regarded as a herald to announce the birth of a great man, or a "pillar of cloud by day and of fire by night" to lead a favourite general on to victory. No doubt clever leaders took advantage of the popular superstition and fostered the belief of their followers that it was an omen of success and a visible pledge of the Divine assistance thus bringing about the desired result, although from a different reason to that assigned. Diodorus Siculus says (B.C. 344): "On the departure of the expedition of Timoleon from Corinth for Sicily the gods announced his success and future greatness by an extraordinary prodigy; a burning torch appeared in the heavens for an entire night and went before the fleet into Sicily." In the year B.C. 48, during the war between Cæsar and Pompey, Lucanus says that "a comet, that terrible star which upsets the powers of earth, showed its portentous hair."

The fall of famous cities has been connected with the apparition of these dreaded visitors, such as the comet which shone over Constantinople when great misfortunes were impending in the year A.D. 400, and also when the city was captured by the Latins in 1204. The fall of Rome was preceded by a comet, when the Eternal City fell into the hands of Alaric, the Goth. Josephus records that a large comet appeared over Jerusalem when it was beseiged by Titus, and that it was visible for a whole year. Another caused great consternation in A.D. 1000, and was thought to announce the end of the world, as this event had been predicted to take place in that year.

Cometary Legends.—In the year B.C. 1194 we are told by Hyginus that "on the fall of Troy, Electra, one of the Pleiades, quitted the company of her six sisters and passed along the heavens towards the Arctic Pole, where she remained visible in tears and with dishevelled hair, to which the name of comet is applied." This probably refers to a comet which passed from Taurus to the North Pole. We are informed by Pliny that in B.C. 975 the Egyptians and Ethiopians felt the dire effects of a comet. It "appeared all on fire, and was twisted in the form of a wreath, and had a hideous aspect; it was not so much a star as a knot of fire." It is strange how ignorance invested a truly beautiful sight with such a repulsive and terrifying aspect. According to the same historian a comet in the form of a horn was visible at the time of the battle of Salamis (B.C. 480).

In the legendary history of Merlin, the ancient British enchanter, it is stated that on the appearance of a comet he prophesied that Uter, the brother of Ambrosius, on the death of the latter, should rule the kingdom; that a ray from the comet which pointed towards Gaul presaged a son who should be born to him and who should be great in power; and that the ray "that goes towards Ireland represents a daughter, of whom thou shalt be the father, and her sons and grandsons shall reign over all the Britons." These prophesies were justified by

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facts, but they were probably written, like so many others have been, *after* the event.

Comets which have "announced" birth and death.—At the birth of Mithridates a comet appeared, which remained visible for 70 days. We are told that "the heavens appeared all on fire; the comet occupied the fourth part of the sky, and its brilliancy was superior to that of the sun." And the same kind of comet is reported to have been visible for 70 days when that monarch ascended the throne. A comet which appeared in A.D. 132 was regarded as the *soul* of Antinous. In A.D. 858 a comet was seen before the death of Pope Benedict III.; in 869 another announced the death of Lotharius the Younger; in 875 that of Louis II.; and in 877 that of Charles the Bald. A brilliant comet was visible for 40 days and 40 nights at the time of the Emperor Constantine's birth in A.D. 904, and another heralded his death in 959. A comet which appeared for three weeks in the year 942 caused, according to the chroniclers, "a great deal of mortality amongst oxen!" Boleslas I. and Casimir, kings of Poland, saw one of these portents before their death. Our own kings were not neglected, for a comet "announced" the death of Richard I., "the Lion Heart," and another that of James II., King of Scotland, in 1460. The Jews thought the comet of 1208 was a sign of the coming of their long-expected Messiah. A brilliant and beautiful comet which appeared in B.C. 40 or 43 was regarded by the Romans as *the soul* of the great Julius Cæsar endowed with divine honours!

Pliny's Description.—This historian has given us a very quaint description of the different kinds of comets. "Some," he says, "frighten us by their blood-coloured mane; their bristling hair rises towards the heaven. The bearded ones let their long hair fall down like a majestic beard. . . The horse-comet represents the mane of a horse which is violently agitated as by a circular, or, rather, cylindrical, motion." He made a very good guess at the truth in the latter statement, for modern observation has taught us that the tails of some comets do rotate about the nucleus or head. He continues: "There are bristling comets; they are like the skins of beasts with their hair on, and are surrounded by a nebulosity. Lastly, the hair of a comet sometimes takes the form of a lance."

In A.D. 1500 there appeared a "comet of bad omen," which was popularly held responsible for the storm which caused the death of Bartholomew Diaz on his voyage from Brazil to the Cape of Good Hope. There is an extremely thrilling and dramatic account of the comet of 1527, which, I think, was written by an observer gifted with a most remarkable and lively imagination. He says: "The length (of the comet) was of a bloody colour, inclining to saffron. From the top of its train appeared a bended arm, in the hand whereof was a huge sword in the instant posture of striking. From the star proceeded dusky raies, like a hairy tail; on the side of them other raies like javelins or lesser swords, as imbrued in blood, between which appeared human faces of the colour of blackish clouds with rough hair and beards!" Many people were ill with sheer fright on beholding this truly "awful comet."

Those who prophesied misfortune on the apparition of a comet left themselves a convenient loop-hole of escape if the expected calamity did not take place. If things occurred as they predicted, well and good, and they were regarded as great prophets, but if they did not, then "the prayers of penitence had turned aside the wrath of God," so that whatever happened, the astrologers were right in the eyes of the multitude. They also taught that any event foretold by the comet might not take place for one or more periods of 40 years.

In the "History of Prodigies" we read: "These signs and prodigies give warning that the end of the world is come, and with it the terrible last judgment of God," and this idea was held by most people until about the end of the 17th century. The comet of 1630 was associated by Ripamontius with a great pestilence.

A very brilliant comet which appeared in 1680 was, perhaps, the last to be regarded as a prodigy. The wildest terror prevailed, some believing that another deluge was coming as "water was always announced by fire." Many people made their wills and gave their property to the Church; whilst others thought that some person of exalted rank would die. To add to the general panic, it was reported that a hen at Rome had laid an egg on which was drawn the picture of a comet. Bernouilli said at this time: "That if the body of a comet is not a visible sign of the anger of God, *the tail may be.*" Even Whiston considered it possible that the approach of a comet caused the Biblical deluge. Newton, on the contrary, maintained that they were beneficial, and fed the sun with light and heat. He also thought that the most useful parts of the atmosphere were derived from them.

Modern Panics.—In 1773 all Paris was terrified by the approach of a comet which, according to a memoir by Lalande, might come within about 40,000 miles of the earth and cause (through pressure) the sea to leave its bed and cover part of the land. The popular fear subsided when he stated that, in any case, this would not happen until after 20 years. Biela's comet, which returned in 1832, also caused much dismay when Damoiseau found by calculation that it would pass through the plane of the earth's orbit on October 29. The papers immediately concluded that a collision would take place, and that our globe would be destroyed; whereas, as a matter of fact, the earth was about a month's journey from the threatened point in her orbit. Similar scares occurred in 1840, 1857, and 1872. With the advance of science and the spread of astronomical knowledge, all fears have passed away, and there are but few writers left who seriously believe that any terrible calamity would happen, even if a cometary body succeeded in penetrating the dense atmosphere of the earth. In these days, when celestial occurrences are subjected to rigid scientific inquiry, leaving little room for imagination, it is, perhaps, of some interest to quote again the ancient records of the time when men groped for the truth, and lived daily in a world of "wonders" far beyond their powers of description or comprehension, and with every modern discovery of the laws of the Universe, our awe but increases until we are constrained to cry: "Great and marvellous are Thy works, and Thy wonders past finding out, and in Thy temple everything saith 'Glory.'"

Editorial Announcement.

AN enlargement of "KNOWLEDGE" is contemplated by its Directors; and will probably be in a sufficiently advanced stage for realisation next year. The enlargement will afford scope for a larger number of articles and for the treatment of subjects, such as those connected with some aspects of physical and mechanical science, for which the periodical cannot at present find room. A special feature of the enlargement will be the publication of a number of full-page plates and an increased number of illustrations. The cost involved by these alterations may entail an increase in the price of "KNOWLEDGE." A more definite announcement on this and other points will be made later.

The Making of Handwriting.

By C. AINSWORTH MITCHELL, B.A. (Oxon.), F.I.C.

HANDWRITING is an inheritance from one's ancestors modified more or less by one's own individuality and by external influences. These distinctive modifications form the marks by which we can, as a rule, at once recognise a particular handwriting, for they are usually as characteristic of a man as are his little mannerisms of speech and gait. Even the frequent alterations that may be observed in the writing of certain individuals are indicative of character.

It does not, however, come within the scope of the present paper to discuss to what extent handwriting may indicate character, but rather to deal with the various psychological factors that tend to modify writing, and to accentuate the differences in two or more handwritings inherited from the same ancestors.

With regard to the inheritance of handwriting there can be no doubt. Instances of close resemblances between the writings of the members of one and the same family will readily occur to everyone. A particular slope in the writing or a mode of looping the letters, or of forming certain words may be passed on for several generations, especially when they originate from a man or woman of pronounced individuality.

It is, of course, almost impossible to decide from which ancestors all the inherited features in one's handwriting may have been derived, just as it is difficult to trace the origin of certain obviously inherited traits in one's character. It is hardly safe to generalise from even a considerable number of isolated instances, but without going so far as to say that such is the rule, it is yet a remarkable fact that there is frequently a tendency for the sons to inherit certain characteristics in the father's handwriting, and for the daughters' writing to resemble more closely that of their mother than that of their father.

The following words (Fig. 1) written by the members of one family afford a typical illustration of this tendency. The first two lines show the respective handwritings of the father and mother. The third, fifth, eighth, and ninth lines were written by their daughters, and the fourth, sixth, and seventh lines by their sons.

It will be noticed, among other points of resemblance, that the bold characteristic looping of the letter L in the mother's handwriting is reproduced more or less closely in the writing of all the daughters, while the sons form the same letter with a small loop as in the word written by their father. The angles at which the different words are written also show the effect of this parallel heredity as it might be termed.

While possessing such points of resemblance obviously inherited from the parents' handwriting, the writing of each of the children also shows characteristics that distinguish it from the writings of the others —characteristics partly inherited from other ancestors and partly the result of environment.

We usually speak of *hand*-writing, though the hand is only the trained instrument of a special area in the brain commonly termed the *writing centre*, which may express itself by other means than the hand. Years ago it was demonstrated by Dr. Preyer that the *foot*-writing of a man who had lost both his hands showed the same characteristics as his former handwriting. It has also been found that words written with a pencil held in the mouth or in the bend of the knee will show indications of the distinctive features of the handwriting of the same individual.

This writing centre is not identical with the speech centre in the brain, for the power of writing may be retained after total loss of speech; or a man may suddenly lose his power of forming letters, though still able to speak, as was the case with a patient of Professor Lombroso, whose attempts at writing are shown in Fig. 2. Yet the fact that aphasia is frequently associated with agraphia points to a close relationship between the two areas.

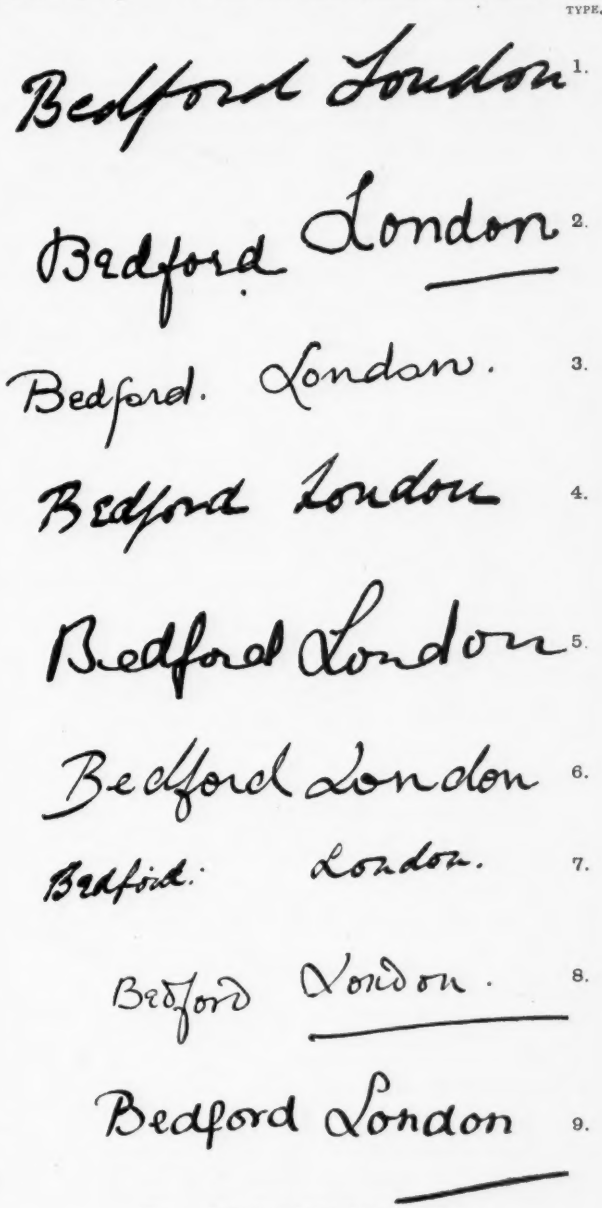

Fig. 1.—Inherited traits in handwriting.

This is strikingly illustrated by a case recorded by Holder of a man who, after having lost his power of speech through a paralytic seizure, gradually regained it with the exception of the sounds of *f*, *l*, and *r*, which he always subsequently omitted in speaking. He was also unable to write the same three letters and replaced them by strokes.

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Whether the writing centre is a large diffused area or is small and circumscribed is unknown, but it appears to be bilateral and to have its seat in both hemispheres of the brain. Thus, in cases of paralysis of the right hand through injury to the left side of the brain, the left hand is readily trained to write.

The phenomenon of mirror writing points to the same conclusion of the duality of the writing centre. This backward writing is not uncommon with weak-minded or neurasthenic children, and is also a frequent result of the first attempts of perfectly healthy children to write with the left hand. Often at the close of a writing lesson a wearied child will involuntarily write some of the capital letters, especially E, backwards.

An instance of mirror writing is shown in Fig. 3. This was done by a girl of 14, who lives in an English village. Though quick enough in her talk and at play, she is excessively dull at school, and can barely read.

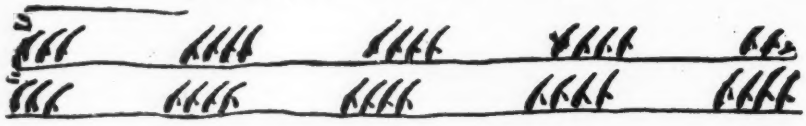


Fig. 2.—A case of agraphia.

When told to write anything, she holds her pencil in the left hand and slowly forms each letter backwards from right to left. It is only with the utmost difficulty that she can manage to write a few words forwards in the ordinary way.

It has been found by Dr. Preyer that most men who have written much with the right hand produce mirror writing with the left hand when they attempt to write with both hands simultaneously. The same thing has been observed in cases where a man has succeeded in writing with both feet at once, the characters formed by the left foot being reversed.

Both agraphia and mirror writing, however, are pathological in character, and cannot be included among the ordinary influences that contribute to the making of normal handwriting.

Writing may be regarded as normal when the thoughts of the writer are centred upon what is being

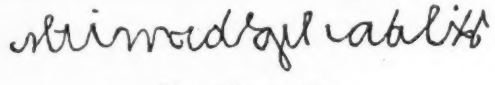


Fig. 3 —Mirror writing.

written, and without a mental side-glance at the form of the writing itself. In the latter case various psychological influences may cause the writing to deviate more or less from the normal. For example, the handwriting of an artist may at different periods show marked variations, especially in the form of the capital letters, for the artist is particularly prone to keep before his eye the decorative effect of his letters and words, and to be constantly making experimental changes in his writing.

In like manner handwriting is often influenced to a considerable extent by subconscious memories of the writing of other people, especially of those whom the writer tries to imitate in other respects. In some individuals this unintentional imitation of other handwriting is so pronounced that they are unable to answer any letter without its characters having some effect upon their own writing.

Conscious imitation is a still more frequent influence upon the form of writing, and some of its effects may become fixed characteristics. Instances of this are to be seen in the "good" writing of the old-fashioned writing master, whose ideal was the copper-plate engraving of the visiting card with its thick downstroke and thin upstroke, and absolute regularity of letter; in the pointed Italian writing taught generally in mid-Victorian ladies' schools; in the Civil Service "hand" set as a standard for securing marks in examination; and in modern commercial handwriting now rapidly giving place to the typewriter.

In all such cases as these, where prolonged attention has been given to the form of every letter, the handwriting is largely an acquired one, though in time it tends through habit to become the normal writing. Where there has been no conscious imitation or experimental alteration and but little unconscious imitation certain distinctive features in a writing may persist for a very long period. Thus, the angle at which the writing slopes may remain practically the same for years, or the form of a particular flourish beneath a signature will repeat itself almost exactly time after time, and even the absence of a flourish may become a significant characteristic.

Emotional influences often have some effect upon handwriting, though the alterations thus produced are only slight and temporary. Thus, a man weighed down with overwhelming grief will often write in smaller characters than usual, while violent anger will find its expression in the more vigorous cross strokes of the "t's," the heavier dotting of the "i's," and the thickness of the flourish to a signature. On the other hand, slight changes caused by long-continued depression resulting from illness may leave permanent traces upon handwriting.

There are many such temporary influences tending to modify handwriting, but none is more remarkable or affords a better proof of the way in which written characters vary with the condition of the mind than the effect of hypnotic suggestion.

The experiments of Professors Lombroso and Richet have proved that a suggested change of personality under hypnotic influence is accompanied by an appropriate alteration in the handwriting of the subject. Thus, a young hysterical girl, when hypnotised, under the suggestion that she was a child wrote in childish characters.

Still more striking were their experiments upon a Trieste student, Chiarloni Clementino, who, within little more than an hour, was made to assume successively the characters of a child, of a peasant woman, of Napoleon, of Garibaldi, of a clerk, and of an old man of 90. He was made to write some words in each of his assumed characters, and the writings not only differed to a marked extent from his normal handwriting, but also had characteristics suggestive of the type of individual he was temporarily personating.

The present writer is greatly indebted to Professor Lombroso for permission to reproduce here the results of some of these experiments. Fig. 4 shows the normal signature of the hypnotised student, Fig. 5 his writing

as Napoleon, Fig. 6 as the old man of 90, and Fig. 7 as Garibaldi.

The handwritings of the suggested Napoleon and Garibaldi were quite different from the writing of the real individuals, though it is interesting to note that there is some attempt to form the letters of Garibaldi's signature in the same way as in the genuine signature (Fig. 8).

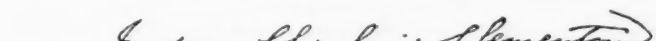


Fig. 4.

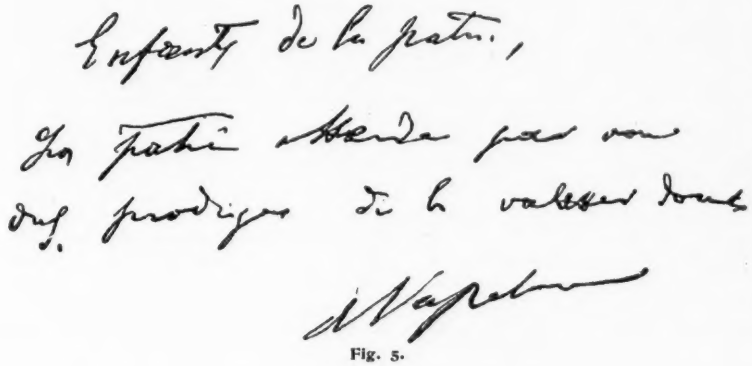


Fig. 5.

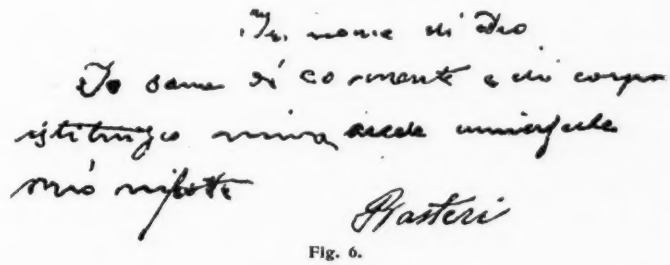


Fig. 6.

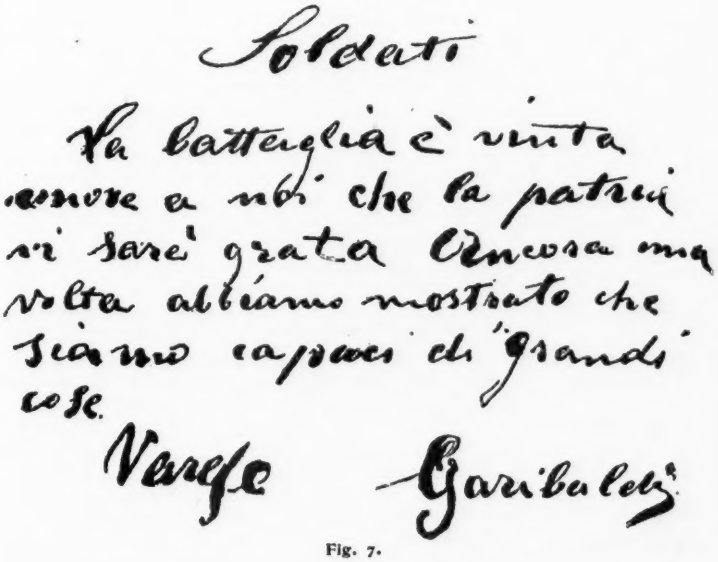


Fig. 7.

In a private communication to the present writer, Professor Lombroso states that it is quite possible for the hypnotised student to have been familiar with the signature of Garibaldi exhibited in different museums in Italy. Or, again, the hypnotisers may have had their thoughts upon the form of the genuine signature while the student was writing the suggested version of it. Further experiments in this direction would be instructive.

It has been observed by Dr. Preyer that certain individuals, when under hypnotic influence, have better handwriting than they have in their normal condition, whereas in the case of other subjects the letters are childish and badly formed.

It is even possible to make them omit by suggestion particular letters from each word they write, "Europe," for instance, becoming "Urop," and so on; while by further suggestion they will again make use of the missing letters.

The fact that handwriting may be completely altered under the influence of hypnotism is not only of great scientific interest, but may also have a practical bearing on the results of legal cases in which handwriting is concerned.

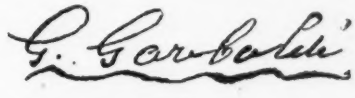


Fig. 8.

It was pointed out some years ago by Dr. Bianchi that hysterical women are particularly prone to write anonymous letters, and it is well known that such women are readily responsive to hypnotic suggestion.

Facts such as these suggest how necessary it may often be to take into account the possibility of hypnotic influence before deciding upon the authorship of a given piece of writing.

To what extent should a man be held responsible for what he has written as the result of hypnotic suggestion from another person? The answer will obviously depend upon whether he was the dupe or the willing instrument of the hypnotiser. In the latter case it will be difficult to prove that the writing is his, for it will be probably very different from his ordinary handwriting. In fact, is it his?

In the present state of knowledge the average jury of to-day is scarcely competent to deal with a case of criminal libel in which such delicate points as these might be raised.

Photography: Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

The Action of Resin, &c., on a Photographic Plate.

Dr. W. J. Russell is continuing the work that has occupied his attention for the last twelve years or so, and has just communicated to the Royal Society the results obtained with resin and some allied bodies. Resin or colophony behaves in a more or less similar way to zinc and some other metals, boiled oil, turpentine, wood, hydrogen peroxide, etc. When placed on a plate in the dark it renders the silver salt developable. The effect is produced in two or three days at ordinary temperatures, but at 30° to 40° C. three or four hours is sufficient. A current of air carries the active substance, whatever it may be, along with it, so that contact between the resin and the plate is not necessary. The active substance creeps round the edges of a screen as if it were a vapour; it passes through paper and analogous porous materials, but it cannot penetrate the thinnest sheets of glass, mica, or aluminium. No effect is produced in an atmosphere of carbonic acid, so that it appears that free gaseous oxygen is necessary. If Bristol board takes the place of the plate, the board itself becomes active, presumably by absorbing the active substance given off by the resin. Fusion of the resin for three or four hours much decreases its activity; a few minutes' immersion in a sulphurous acid solution destroys it; while sunshine or the light from an electric arc increases it to a certain maximum. In a spectrum, the action of light decreases from the blue to the green, and becomes nothing in the red.

Abietic acid, the chief constituent of resin, when chemically separated from the crude substance, is also active. Fusion renders it inactive, but by powdering it or roughening the surface of the cake it becomes active again. Its salts are inactive. Turpentine, which is separated from resin by distillation, is a very active substance, but its activity is almost entirely removed by digestion with a caustic alkali or magnesia, so that its activity may, perhaps, be due to an acid constituent, and, perhaps, the activities of resin and turpentine have a common origin. Amber has very little effect on a photographic plate, but the residue obtained by evaporating an alcoholic extract of it is very active. Lignite and graphite are without action on a plate, jet has a very slight effect. All the samples of coal examined were active, and while a preliminary heating for twenty-four hours at 100° C. increased the activity, was destroyed by heating for a like period at 200° C.

W. Schmidt, finding that the gum on some envelopes had become non-adhesive, traced the effect to the action of printing on the reverse side of the paper, and so was led to investigate the action of a film of drying oil on photographic plates when placed at a little distance from them. He speaks of the action as "radiation phenomena," but gets the same results as others have obtained before. By continuously exposing eight parts of a plate to an active film and removing and developing one part every two hours, he obtained in the longest exposures complete reversal. An experiment made to test the possibility of reflecting the "rays" by means of a brass plate must be regarded as quite inconclusive.

The Action of Hydrogen Peroxide.

The action of hydrogen peroxide in producing the developable condition continues to engage the attention of investigators. This matter is, of course, intimately connected with the subject of the previous section, as Dr. Russell has found that peroxide of hydrogen is produced by those substances which affect the photographic plate under the conditions of his experiments, and he ascribes their activity to its production. It has been just shown by O. and A. Dony-Henault that if the vapour tension of hydrogen peroxide is increased its photographic activity is also increased, and that the presence of water vapour increases its activity. The authors, therefore, conclude that when hydrogen peroxide renders the silver salt of a plate developable, the effect is due to the actual transfer of the peroxide in the form of vapour from its source to the photographic plate, and not to radiant energy. Looking at the question broadly, as I said last April, our knowledge seems hardly full enough as yet to form a theory of the action, except, of course, those tentative hypotheses that are necessary as suggestions of lines along which to pursue research. And it must be remembered that the action at a distance of these so-called "active" substances has been found to take place under experimental conditions which were supposed to render the formation of hydrogen peroxide impossible, and that the variety of substances that give rise to it is considerable.

The Effect of Temperature on Sensitiveness.

Mr. R. J. Wallace has communicated to the *British Journal of Photography* the results of experiments made for astronomical purposes on "Seed 27 Gilt Edge" plates, with regard to the effect of temperature on their sensitiveness. Sir W. Abney found in 1895 that by warming a plate its sensitiveness was increased, while some three years ago Mr. E. S. King, of Harvard College Observatory, got a decrease of sensitiveness by warming the plate. Mr. Wallace finds that these apparently contradictory results are both in agreement with his observations, the warmer plate giving a steeper curve of gradation which crosses the curve obtained by exposure at a lower temperature, so that for feeble exposures the warmed plate is less sensitive than the cooler plate, and for stronger exposures more sensitive, or, in other words, for the same exposure gives more exposure effect or more density on development. Thus it appears that with this particular plate and under the conditions of these experiments (and, perhaps, also under other conditions and with other plates), the "speed" of the plate when estimated according to the H. and D. method is increased by lowering the temperature of the plate during exposure. But it cannot be too emphatically stated that the H. and D. method is only one method of estimating sensitiveness, and may give misleading results. Sensitiveness is not an absolute and independent property of photographic plates, and the only way to be sure of estimating it for scientific work is to estimate it under the same conditions that will hold during the use of the plates. It may seem strange that cooling a plate should make it more sensitive, seeing that many chemical and physical changes are rendered more sluggish by lowering the temperature of the reagents involved; but, on the other hand, a high temperature often retards change as when it prevents the combination of substances that readily unite at lower temperatures.

Miscellanea.

The new "Descriptive List" of dry plates, colour filters, and safelight screens, which Messrs. Wratten and Wainwright, of Croydon, send to applicants, includes a concise essay on the use and uses of these specialities of the firm. The large variety of colour-screens and colour-sensitised plates that they issue are scientifically classified, and will appeal particularly to those who have special photographic work to do.

Solar Disturbances During September, 1908.

THERE has been a continuance of activity on and around the sun all through September. The longitude of the central meridian at noon on the first of the month was 18° 25′.

Nos. 123, 124, 125, 125*a*, 128, and 129 all appeared on last month's chart, but were visible during the early days of September. No. 125 is remarkable as being the seat of a terrific and brilliant eruption of hydrogen and helium observed by Mr. Buss at 1.40 p.m. on 2nd.

No. 128*a*.—A pore seen 4th to 7th.

No. 130.—A spot, at first solitary, 25,000 miles in diameter, pores around began to show on 7th, next day it assumed a somewhat spiral character, with a whorl of pores around its northern edge. Evanescent pores seen until 13th. Visible 3rd to 15th.

No. 130*a*.—A pair of pores seen only on 10th.

No. 131.—Two pores 15,000 miles apart seen 2nd-3rd.

No. 132.—A spot 27,000 miles in diameter. Seen to have spots following on 6th, which developed to a group 119,000 miles in length, showing great activity, but began to break up on 13th. Seen 4th to 15th.

No. 133.—A group of small spotlets 37,000 miles in length 6th to 9th, the *p*. portion died out, whilst only a pore remained 12th and 13th.

No. 134.—A changing group 44,000 miles long 8th to 13th, when it seems to have died out.

No. 134*a*.—A very similar group, 55,000 miles in length, broke out nearer the equator, remaining visible 14th to 18th.

No. 135.—A solitary spot 18,000 miles in diameter very slowly dwindling, seen 10th to 22nd.

No. 136.—On 14th two spots were seen, the larger leading, both having multiple umbræ. Both expanded, the larger being 25,000 miles in diameter, and on 17th and 18th a gray patch was south of the preceding spot. A third spot had developed 19th and 20th, and by 23rd the rear spots had broken into pores and were not seen on 24th. 14th to 26th.

No. 136*a*.—On 24th two large spots, nearly 20,000 miles in diameter, when last seen, on 25th, had a very altered appearance.

No. 137.—A little group of pores, which soon assumed an oval form, only a pore remaining on 19th. 17th to 19th.

No. 138.—A pore only seen 17th and 18th.

No. 139.—Two spotlets on 18th, then four, the leader being largest, on 22nd only the one spot; a cyclonic-looking whorl of pores surrounded this spot from *n.n.p.* to *f*. on 23rd. These became more scattered until 26th. Only the one spot 27th and 28th.

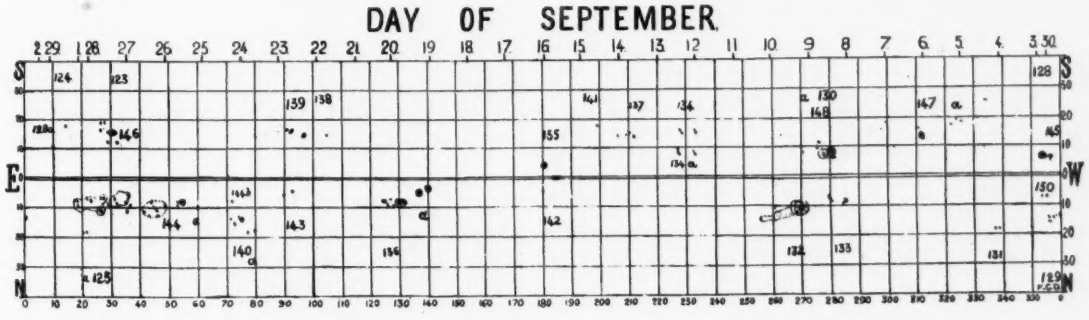
No. 140.—A spot 18th, but accompanied by a pore 19th, solitary 20th, a pore close East 22nd to 25th, with two others also on 23rd. Its maximum diameter was 8,000 miles, but on 26th, when last seen, reduced to a pore.

No. 140*a*.—A pair of pores only seen 26th.

Nos. 141 and 142.—Solitary pores seen one day only, on 19th and 20th respectively.

No. 143.—A pair of pores 34,000 miles apart, seen only 19th and 20th.

No. 144.—A loose group of spots in front of the place of No. 125, as that was in front of No. 111, and situated in a vast faculic area. The leader increased to 12,000 miles in diameter, and had a few pores around it. The other spots formed a detached group showing constant change within an oval area. Spectroscopically the group was intensely active, and on September 30th at 2.30 p.m. a brilliant eruption of hydrogen and helium occurred between the two parts of the group, a volume of hydrogen being driven over 146,000 miles in not more than eight minutes. This group was 112,000 miles, and seen from September 22nd to October 2nd.



Nos. 144*a* and 144*b*.—Two pores ahead of the group seen on 26th and 30th respectively.

No. 145.—A small spot 24th until October 2nd. Alone except on 29th, when it was accompanied by a pore, and 30th by a grey marking.

No. 146.—An active area in which evanescent pores showed, two 25th, and two different ones 26th.

No. 147.—A spot 14,000 miles in diameter September 27th till October 9th. Tiny companions varying in number and position on 28th, 29th, 2nd, 3rd, and 4th.

No. 147*a*.—A group of pores 36,000 miles long 30th, two only October 1st and 2nd, and one on 3rd.

No. 148.—A return of No. 130, but just behind its old place. Its diameter was 20,000 miles, and was visible September 29th till October 12th. From 30th till 7th it was accompanied by a varying group of pores having a maximum length of 16°.

No. 149.—A spot 26,000 miles in diameter, a return of No. 132, also just behind its former place. Pores close behind it on October 6th and 7th. September 30th till October 12th.

No. 150.—Two pores in an active area in the centre of the disc September 30th and October 1st.

Our chart is constructed from the observations of Messrs. J. McHarg, A. A. Buss, A. Mee, and F. C. Dennett.

CORRESPONDENCE.

Euclid's Definitions.

To the Editors of "KNOWLEDGE & SCIENTIFIC NEWS."

SIRS,—That Euclid's Geometry constitutes a perfect example of the application of the principles of logic is an argument frequently employed by Euclid's supporters. It will be of interest to see how far this claim can be maintained. That Euclid, in general, manifests a logical sequence cannot be denied, certain defects, however, have not escaped the notice of modern mathematicians, such as the neglect of Euclid to prove that all right angles are equal, and the unnecessary introduction of prop. 7 bk. 1.

It is, however, in his definitions that Euclid commits his fundamental logical errors. The majority of the definitions depend upon that of the straight line, and this is defined as a line which lies evenly between its extreme points; in other words, a straight line is a straight line! A better (or rather worse) example of *circulus in definiendo* would be hard to find. Other more modern definitions of the straight line, with the exception employed later, appear to be equally objectionable. Thus, for example, we sometimes find a straight line defined as the shortest distance between two points. This definition implies the comparison of two distances, but the comparison of distances involves a knowledge of what is implied by a straight line, for curved lines are measured by supposing them to be made up of a very large number of straight lines. So that this definition is also illogical. It is also rather surprising to find it followed by a proof (*per* Euclid) that the two sides of any triangle are together greater than the third, a proof which would be quite unnecessary if the definition is valid.

It is impossible to exaggerate the importance of correctly and logically defining the straight line, inasmuch as upon this hangs to a great extent those momentous geometrical questions involved in the theory of parallels. That Euclid's treatment of such questions is unsatisfactory is generally admitted. The object of the present letter is to try and find a system of logical definitions.

Euclid's or modern definitions of the point, line, surface, and volume are satisfactory, but would preferably be given in the reverse order. And here we part company with them, to seek a more logical method than adopted as yet. Now, of all the geometrical figures that can be satisfactorily and logically defined without reference to other definitions save the above, there appears to be one, and one only—the sphere.

Our fifth definition is, therefore, the sphere: a solid figure bounded by one surface, which is such that all points in this surface are symmetrically arranged about a certain point within the figure. And this point is called the centre. Or if the expression "symmetrically arranged" be objected to, the sphere could be defined as a solid figure bounded by one surface which is such that the distance between any point in the surface, and a certain point (called the centre) within the figure is constant. This latter definition involves "distance," and it might be thought, therefore, that it comes under the objection already noticed. This is not so, for I am not concerned here with absolute distance or even relative distance in the sense of greater or less, but merely constancy of distance, and this constancy could be indicated by any line not necessarily straight. In other words, the sphere can be defined as a solid figure bounded by one surface, which is such that if any line (of indefinite length) be rotated in all directions about a certain point (called the centre) within the figure it will always be cut by the surface in one and the same point. This is exactly what is implied by "symmetrically arranged."

Having defined the sphere we can proceed to the plane (Def. 6). A plane is a portion of the surface of a sphere which has been increased in magnitude without limit. The circle can now be defined as (Def. 7) a plane figure bounded by one line (called the circumference), which is such that all points in this line are symmetrically arranged about a certain point within the figure. And this point is called the centre. Any objection to the expression "symmetrically arranged" can be overcome similarly as in the case of the sphere.

At last it is now possible to logically define the straight line. Def. 8. A straight line is part of the circumference of a circle which has been increased in magnitude without limit. And it can then be stated that the radius of a sphere (or circle) is the straight line joining any point in its surface (or circumference) with the centre.

Parallel straight lines can be defined as great circles of a sphere of infinite radius. And similarly the rest of the definitions readily follow.

This system of logical definitions is remarkable in that it clearly demonstrates the *fundamental nature of the geometry of the sphere, and that plane geometry is to be regarded as a particular branch of this.* Thus logically, spherical geometry should be studied first and afterwards the particular case in which the radius of the sphere is supposed to be increased without limit, *i.e.*, plane geometry. This method would, we feel confident, overcome the fundamental difficulties involved in the theory of parallels.

That such a method for teaching geometry to the young (mentally young that is) would be practically useless is admitted, for, apart from the intrinsic difficulties connected with spherical geometry from the teaching standpoint, the conception of the mathematical infinite is introduced early into the study. However, the expressed object of this letter is to find not an easy geometry, but a logical one.

In teaching geometry it appears that there are two courses to choose from—(1) Make the best bargain possible with logic, and teach Euclid or his modern successors. (2) Recognise the difficulties connected with a logical study of theoretical geometry and defer the subject to a later date, employing the time meanwhile with practical geometry instead. It is not my object to decide between the above two courses, but it would be, at least, of great interest if a text-book of descriptive geometry were forthcoming written upon the basis we have herein attempted to lay down and following the treatment suggested.

Yours, etc.,
H. STANLEY REDGROVE, B.Sc.

Oscillatory Discharge.

SIRS,—A narrow strip of glazed paper was placed between the points of a glass-perforating apparatus, the plane of the paper being at right angles to the line joining the points. It was quickly drawn out as a spark was produced between the points by a Leyden jar, charged from a Wimshurst machine. This experiment was repeated several times. On examining the papers it was found that there were more than one hole in each case. The maximum number of holes was six. These were all in a straight line, and the diameters of the holes diminished gradually. I concluded that this was due to the oscillatory character of the Leyden jar spark. When the paper was held in a plane inclined to the line joining the points (and, therefore, to the line of spark) only one hole was made. This may be explained by the fact that as the spark passed obliquely, only the component of it at right angles to the paper is to be considered, and of the alternate discharges of this component only the first was powerful enough to perforate the paper.

Yours, etc.,
P. BHATTACHARYYA.

The Fall of Meteors.

SIRS,—In Mr. Gore's admirable article in the last number of "KNOWLEDGE" there is one point on which I fail to see the force of the argument, with reference to M. Ricco's experiments.

The image of the sun when near setting is distorted from the circular to the elliptical form, owing to the fact that the refraction being considerably greater near the horizon than just above it, "the bottom of its disc is lifted up 6′ more than the top and the vertical diameter is made one-fifth shorter than the horizontal" (see Young's "General Astronomy," §93, and other works). Thus the reflection in the water must also be similarly distorted.

With reference to the meteorite which the Emperor Jehangir had made into a sword, there is a translation of his own account of the occurrence of its fall, etc., in Phil. Trans., 1793, p. 202 (see Herschel's "Outlines of Astronomy," §898). Humboldt records that two Mexican monks were killed by the fall of meteoric stones.

Yours, etc., F. W. HENKEL, B.A., F.R.A.S.

NOTES.

ASTRONOMY.

By CHARLES P. BUTLER, A.R.C.Sc. (Lond.), F.R.P.S.

Comet Morehouse (1908 c).

NUMEROUS observations of this comet have been made during the past month, from which it appears that the object has been subject to conspicuous changes both in brilliancy and structure. About the middle of October a very noticeable development of the tail system was observed; on the 14th there were seven distinct streamers. It would also appear that the nucleus has also been somewhat variable, both in size and magnitude. Towards the end of October the comet was visible to the naked eye, and with the aid of an opera glass or small telescope, the tail could be traced for about 2°, extending from the nucleus in an easterly direction. During November the comet may be found passing almost due south through the constellations Aquila and Serpens.

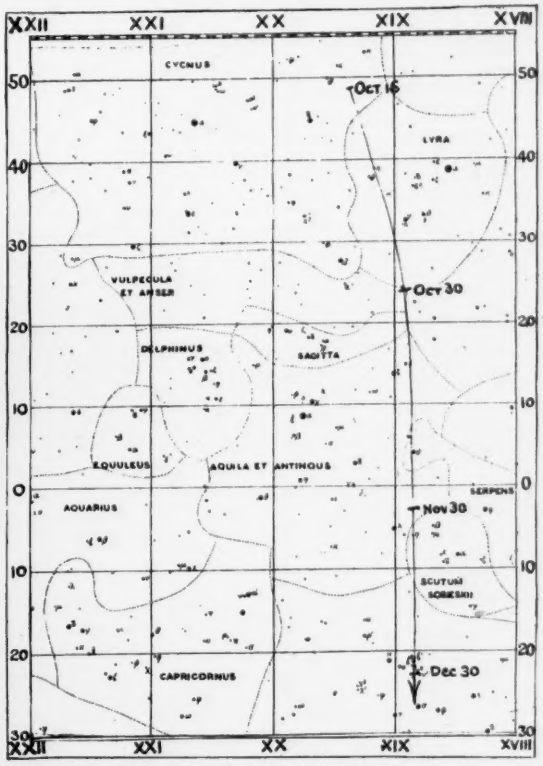
October 12, 1908.

October 14, 1908.

October 23, 1908.

Comet 1908 c. (Morehouse).

Photographs taken with the 36-inch reflector at the Solar Physics Observatory, South Kensington, showing varying types of tail. The relative brightness of the pictures is not comparable as unfavourable weather prevented similar lengths of exposure being given.



Path of Comet 1908 c. (Morehouse).

It is also important to note that the various ephemerides that have been published from time to time have all failed to agree with the observed positions of the comet for any extended period, although they appear to have been computed from accurately determined standard positions. This may subsequently be accounted for by special perturbations, which might at the same time explain the irregular variations in brightness and structure, and it is to be hoped that this question will not be overlooked.

EPHEMERIS FOR GREENWICH MEAN, MIDNIGHT.

1908.	R.A.	Decl.	Brightness.
	h. m. s.	° ′ ″	
Nov. 2.5 ..	18 56 56·1	+ 20 43 30	5·38
,, 10.5 ..	53 03·2	+ 10 55 15	
,, 26.5 ..	50 32·1	− 3 22 55	
Dec. 12.5 ..	50 11 0	− 13 25 45	
,, 28.5 ..	18 49 54·8	− 21 33 54	3·84

New Ring to Planet Saturn.

The observers at the Geneva Observatory report that they have discovered a new dusky ring surrounding the bright rings of Saturn. (*Kiel Centralstelle Circular*, No. 104, October 8, 1908.)

Solar Observation in Canada.

The recent news from the new Dominion Observatory at Ottawa is most encouraging. It is announced that the new

solar equipment is now installed, and the scale on which the instruments have been designed is strongly reminiscent of that at Mount Wilson, with which Professor Hale and his assistants have done such splendid work. The Coelostat telescope for research on solar phenomena was installed early in the past summer, and notwithstanding some apparently unfavourable conditions, it is found to give excellent definition. It is placed due north of the west wing of the Observatory in a louvred building, through which there is free air circulation. The central portion, covering the Coelostat and secondary mirror, is largest, and is arranged to roll back on wheels over the rear part containing the concave mirror, in order to allow the sun to shine on the mirror of the Coelostat. The solar beam then passes from the Coelostat southwards to the secondary mirror, then north again to the concave mirror, and finally south, under the secondary mirror through the louvred passage into the basement of the Observatory. The Coelostat and secondary mirror are each 20 inches in diameter; the concave is 18 inches diameter and 80 feet focal length, forming an image of the sun about 9 inches in diameter.

In the optical axis of the concave mirror there is adjusted a Littrow grating spectroscope containing a combined collimator and camera lens of 6 inches aperture and 23 feet focus, and a 6-inch plane diffraction grating, by Michelson. This spectroscope is arranged to rotate round the axis of collimation in order to place the slit in any desired position angle, the angles being read by a divided circle. The camera is placed about 4 inches below the slit, takes plates 12″ by 2″, and is moveable up and down by rackwork so as to take a number of spectra side by side. It can also be tilted so as to obtain the whole length of spectrum in focus. It is intended to employ this instrument for investigation of sun-spot spectra, determinations of the solar rotation period, and other spectroscopic work. A camera for taking direct pictures of the 9″ image formed by the concave mirror is also being erected, and special investigations are to be made of the intensity of solar radiation.—(*Journal, Royal Astronomical Society of Canada*, Vol. II., p. 214., July-August, 1908.)

Halley's Comet.

Enthusiastic preparations are being made at many observatories for the systematic search for this famous comet, which is due at perihelion in the spring of 1910. According to the latest ephemerides it is now well in the solar system, being about as distant as Jupiter.

At the Yerkes Observatory the programme provides for photographic exposures at close intervals throughout the latter part of 1908, and the spring of 1909, but it is not expected that the comet will be visible to the naked eye until late in 1909. It is expected to be easily visible in 1910, passing in January of that year from Aries into Pisces, travelling westwards through the latter constellation until the early days of May; after this it will turn eastwards, passing through the constellations Cetus, Orion, Monoceros, Hydra, and Sextans. Observers desirous of joining in the search would do well to prepare a sketch chart of the region of the sky, including the above regions, and from time to time make a systematic examination of the localities indicated in the ephemeris.

EPHEMERIS FOR PARIS MEAN, MIDNIGHT (Holetschek).

1908.	R.A.	Decl.
Nov. 1.5	100° 36′	+ 11° 32′
,, 11.5	99° 27′	11° 23′
,, 21.5	97° 58′	+ 11° 16′

Comet Tempel-Swift.

This comet, originally discovered by Tempel in 1869, has been found on its present return by M. Javelle, at the Nice Observatory. Its position then was:

R.A. = 6h 44m 14s·6 } 1908, Sept. 29d 15h 9m·4
Decl. = +32° 37′ 55″ } (Nice mean time.)

The estimated magnitude at the re-discovery by M. Javelle was 14.0, and as it appears to be rapidly receding both from the earth and sun there is not much prospect of its becoming a prominent object.

BOTANY.

By G. MASSEE.

Geographical Distribution of Dodonaea Viscosa, Jacq.

DR. KOORDERS has given in *Koninkl. Akad. Wetensch. Amsterdam*, an account of the ecology and distribution of this very interesting polymorphic tree, which has an extremely wide vertical and horizontal distribution.

In Java, it is met with on the flat, sandy beach, and again at an elevation ranging from 1,500 to 2,600 metres above sea level, but is completely absent from the regions between the above alpine stations and those on the beach. It generally grows either socially, forming smaller or larger woods, or it occurs at least in very large numbers. It is completely restricted, when growing wild, to physiologically dry localities, either in alpine regions, or on the sea beach, which is physiologically dry in consequence of its richness in salts. Outside Java *Dodonaea viscosa* is generally distributed in tropical and sub-tropical regions of the whole world, where it occurs either on sandy sea shores, or in inland localities at a considerable elevation.

The inflated, thin-walled, light, winged fruits, weighing about 0,040 gram, and having a surface of 2½ square centimetres, are not only eminently adapted for dispersion by wind, but are also extremely well suited for transport by water. Of some fruits placed in a 3½ per cent. solution of common salt, 80 per cent. still floated after 25 days. Careful observations show that in some instances, the seeds are borne for a distance of 30 kilometres by wind, although it is considered that transportation by stages is much more probable in most instances. The almost complete absence of the species from the broad belt between the sea beach and the mountains, is probably due to crowding out by other plants of such seedlings as may be produced from fruits which undoubtedly frequently fall in the intervening zone. Its general occurrence on tropical shores of the whole world testifies to the great suitability of the fruits for transport by water over immense distances.

The points indicated above, along with the extraordinary power of resistance against drought of both air and soil, against direct sunlight, against the saline contents of the soil, and also against strong winds, together with the property of bearing numerous fruits from the age of two years, fully explain why this tree appears in Java as the pioneer of new vegetation, not only in alpine regions, but also on sandy sea beaches.

As might be expected in the case of a tree ranging over such an extended area, and appearing under such a variety of forms, it has been described as new under at least twenty-five different names.

Return of Vegetation on Mont Pelée and the Soufrière.

During the volcanic eruptions that occurred in 1902 at Mont Pelée, in Martinique, and at the Soufrière, in the Island of St. Vincent respectively, the vegetation of those regions covered by the incandescent avalanche was totally destroyed. In some districts near Mont Pelée the avalanche of lava is several feet in thickness, and the surface has consolidated into a crust nearly an inch thick, almost like a concrete pavement, and where this crust is perfect no vegetation can spring up. On the other hand, where the crust is broken up by watercourses, or by the trampling of horses and cattle, vegetation is reappearing, silver ferns (*Gymnogramme calomelanos*), grasses, and young Plucheas being present.

In other districts, where the hot ash was only deposited in a thin layer, the roots of trees and shrubs were not killed outright, and are now throwing up new shoots and leaves, and the ash is rapidly breaking up under the influence of plant roots, and humus is being formed. The new vegetation consists of castor oil (*Ricinus communis*), which is very luxuriant, *Pluchea odorata*, which has formed bushes higher than a man, indigo, sensitive plant, guinea grass, etc. At altitudes exceeding 1,500 feet only a few grasses and silver

ferns are met with, and at yet greater elevations nothing but mosses and lichens are found.—Dr. Anderson, in *Phil. Trans. Roy. Soc.*, 1908.

Protection of Leaves from Light.

The subject of the protection of green leaves from excess of light has been much investigated of late. K. Baumert, in *Beitr. Biol. Pflanz.*, gives an exhaustive summary of the various means by which this object is attained, according to various observers, and also describes some new observations of his own on the subject.

His results prove that leaves covered with hairs, scales, bloom, etc., also leaves with a shining surface, become less heated than when the same leaves are deprived of these various structures. A dense coating of hairs reduces the heat 37.5 per cent.; bloom or waxy covering, up to 13.5 per cent.; a shining or polished surface, up to 30 per cent.

In some Bromeliads, reflection of light is considered to be due to the inner or lower wall of the epidermal cell, such structures acting as a concave lens.

The Lichen Exchange Club.

The first report gives evidence of a considerable amount of interest in this somewhat neglected group of cryptogams. The distributor, the Rev. H. P. Reader, M.A., Holy Cross Priory, Leicester, gives some good advice as to the desirability of collecting typical specimens. The name of the referee is a guarantee that specimens submitted for examination will be correctly named.

CHEMISTRY.

By C. AINSWORTH MITCHELL, B.A. (Oxon), F.I.C.

The Colour of Red Grapes.

THE colouring matter of red grapes appears to be an oxidation product of a tannin derivative present in the green grapes of either red or white vines. Thus it has been shown by M. Laborde that on heating the solid matter from either kind of green grapes for 30 minutes under pressure with 2 per cent. of hydrochloric acid, an intense wine-red solution is obtained. A similar chromogenic property is possessed by the tannins of cherries, plums, and other fruits, but not by the tannin of oak-bark. A bright wine-red colour is also obtained when the solution of one of these fruit-tannins is boiled with a little caustic alkali, and the colour is permanent so long as air is excluded. If, however, the liquid be exposed to atmospheric oxidation for some hours the colour slowly changes to pale yellow.

From the results of M. Malvezin's experiments, it appears that the formation of colour from the chromogenic substances depends upon the simultaneous action of air and heat, and possibly of light as well. Thus when green grapes from a red vine were sealed in a tube containing water but from which all air had been removed, no red coloration was produced on heating, whereas the same kind of grapes became strongly red when placed in water and exposed for 24 hours to the air at a temperature of about 85° C. Green grapes from a white vine were also changed to a red colour when placed under the same conditions, which shows that they, too, contain the chromogenic substance. In the change that occurs naturally in the grape upon the vine, an important part is probably played by the presence of a specific enzyme (ferment), which acts as a conveyor of oxygen from the atmosphere to the chromogenic substance, and the non-occurrence of the change of colour in white grapes must be attributed to their lacking this enzyme. Similar specific oxidising enzymes, termed *oxydases*, are present in numerous plants, and are a main cause in the discolorations that take place when a cut apple or potato is exposed to the air, and of the bright blue coloration which rapidly appears when certain kinds of *boletus* are broken.

The Fatty Acids in Mummies.

Fat is a compound of glycerin with certain fatty acids, some of which are solid and others liquid. It was shown some years ago by the present writer that human fat consists chiefly of the glycerides of the solid fatty acids, palmitic acid, and of the liquid fatty acid, oleic acid, and it is interesting to know to what extent the fat in mummies shows variations from this normal composition. The recent investigations of Dr. W. A. Schmidt upon this point show that the composition of the fatty acids varies both in quantity and in character with the age of the mummy. Thus in the case of mummies of the Coptic period (about 500 A.D.) the fatty acids consisted in the main of oleic acid and higher solid fatty acids, and thus approximated in composition to those of fresh human fat. The fat had undergone decomposition, however, into its components of fatty acids and glycerin, and only traces of the latter could be detected. The fatty acids from a mummy of the 21st dynasty (5000 B.C.), differed greatly from those from mummies of the latest period. Oleic acid could still be identified, though in much smaller quantity than before, while there was also a large proportion of volatile fatty acids, which had apparently been gradually formed at the expense of the palmitic and other higher solid fatty acids.

Cutting Metals by Means of Oxygen.

A very ingenious method of rapidly cutting through an iron or steel plate has recently come into use. It is based upon the fact that when iron at a high temperature is acted upon by a fine jet of oxygen the resulting iron oxide is more fusible than the iron itself, and passing away exposes a fresh surface of the metal to the attack of the gas, so that a cut is produced along the line of action. In the early attempts to utilise this method in practice, the metal was first heated to the required temperature in an oxy-hydrogen flame, and then subjected to the action of the oxygen jet. Now, however, the heating and oxidation are done at the same time, and the resulting cut is much sharper. In one form of apparatus used for this process the metal is heated by means of an oxy-acetylene flame, from the centre of which issues a jet of oxygen. In illustration of the rapidity with which the process works, some experiments of M. L. Guillet may be cited. For instance, an armour plate $6\frac{1}{4}$ inches thick and $3\frac{1}{2}$ feet in length was cut in two in 10 minutes, whilst manholes could be cut in plates $\frac{3}{4}$ to $1\frac{1}{8}$ inch in thickness in 4 to 5 minutes. In parallel experiments upon the same piece of metal, a groove $1\frac{1}{2}$ to $2\frac{1}{2}$ inches deep was cut by the oxygen process in 7 minutes, whereas with a pneumatic chisel a groove of about the same length but only one-quarter as deep took an hour to cut. The new method has also given very satisfactory results in the rapid removal of the heads of rivets when plating has to be separated, only a few seconds' treatment being necessary for fusing off the head of a rivet $\frac{7}{8}$ inch in thickness. With regard to the effect of the oxygen upon the metal adjoining the cut, experiments have shown that the depreciation is but slight.

GEOLOGY.

By EDWARD A. MARTIN, F.G.S.

The Great Canadian Glaciers.

THE results of the expedition undertaken by the Smithsonian Institution in 1904, amongst the glaciers of the Canadian Rockies and the Selkirks, have been brought together by Dr. W. H. Sherzer, of Michigan, and published in a volume of 135 pages, which is enriched by 42 plates illustrating photographically various interesting points in glacial science. Five glaciers have been examined and described, the largest, the Yoho glacier, extending more than three miles below its névé field, and a mile in width for two-thirds of its length. Considerable light has been thrown upon glacier formation and upon various unsettled problems in pleistocene geology. The other glaciers examined were the Victoria and Wenkchemua, in Alberta, and the Asulkan and Illecillewaet glaciers, in British Columbia.

The Yoho Glacier.

The mean elevation of the Yoho névé is 8,400 feet, and the nose descends to 5,670 feet. The mean average slope from

the névé to the nose is about 900 feet to the mile. Since its first discovery this glacier has maintained a grand archway of ice at its lower extremity. The span of this arch is no less than 250 feet, and its height is estimated at 70 feet, whilst from beneath the arch the drainage escapes. The formation of this arch appears to be an annual phenomenon. Towards the close of the summer it becomes weakened by melting and the whole structure collapses. The ice is gradually broken up and finally removed, and the formation of a new archway is commenced. From the archway issues the Yoho river. In contrast to the work of other glaciers as engines of transportation, in the case of the Yoho we have, it is said, very plainly a great engine of erosion.

Retreat of the Glacier.

The moraine of the Yoho consist of stony till, or ground morainic matter. Its general surface is practically free from coarse rock *débris*, in consequence of the lack of overtowering cliffs. Lateral moraines are thus poorly developed and almost absent in the last half-mile. There is an old lateral moraine which is now some 200 or 300 feet above the margin of the ice, although it is but three or four feet in height itself. It may be traced for some 2,000 feet up the valley from the nose, and has, heaped over it, a mass of broken tree trunks, which appear to have been brought down by an avalanche, and brought to rest when the ice stood at the height of this morainic ridge. It has been calculated that the avalanche must have occurred between 1850 and 1860, and the retreat of the glacier down the slope has been at the average rate of 5 to 6 feet per annum. From August, 1901, to August, 1904, it was found, by reference to certain marks placed by Miss Vaux and Mr. Du Bois, that the glacier had receded a distance of 111 feet, or 37 feet per annum. Between August, 1904 and August, 1905, the retreat was but 9 feet, and it is argued from these and other data that the retreat of the glacier is being checked.

Plucking Action.

About the nose of the glacier there is evidence of bodily disruption of the rock strata, to which the term "plucking" has been applied. Rock layers are ripped off, when the layers are thin-bedded and jointed, and the fragments are pressed into the ice to assist in further work. The bed of the glacier is in such cases lowered with relative rapidity, and the result is frequently that instead of the bed being smoothed, it is much roughened by ice-action, this being in striking contrast to the usual accepted proofs of the former work of moving ice.

Movement of the Victoria Glacier.

The forward rate of movement of the Victoria glacier in Alberta, has been attested by a series of experiments. The position of a large boulder was marked by Messrs. Vaux in July, 1899. By July, 1900, this boulder had moved forward 147 feet, while another near the terminal moraine was found to have moved 115 feet. But the most important evidence of the forward movement of the ice-surface was obtained by observing the behaviour of certain steel plates, each 6 inches square, with a 9-inch piece of gas-piping screwed into the centre. There were 18 of these plates in all, and they were placed across the glacier at an average of 100 feet from one another. The total distance across the glacier was 2,167 feet. The line of plates was 3,600 feet back from the nose of the glacier, and were painted a brilliant red colour, and were numbered. Plate No. XI., the one nearest the centre of the glacier, exhibited the greatest movement. For the period of 423 days, from July 9, 1904, this plate moved forward 76.3 feet, or a daily average of 2.165 inches, and a yearly movement of about 66 feet. In comparing the movement during 10 cool days with that during 10 warm days, plate XI. moved 19.882 inches in the former, and 33.661 in the latter, the greatest movement being in the case of most of the plates when the melting was the greatest. The table containing these data suggests, the author adds, "that during the season of maximum motion there are cross-currents set up in the ice," and possibly even back currents, except at the bed of the glacier.

METEOROLOGY.

By WILLIAM MARRIOTT, F.R.MET.SOC.

The Recent Warm Weather.

ABNORMALLY high temperatures prevailed all over the country from September 29 to October 4. At the Royal Observatory, Greenwich, the maximum temperatures registered on these days were:—

Sept. 29 ...	75°.2	Oct. 1 ...	77°.8	Oct. 3 ...	78°.0
Sept. 30 ...	79°.9	Oct. 2 ...	78°.5	Oct. 4 ...	75°.2

There have been only thirteen occasions since 1814 on which the temperature in the month of October at Greenwich has exceeded 75°, and of these, as will be seen from the above, four have occurred in the present year. The other instances are:—

1834 ...	Oct. 5 75°.5	1886 ...	Oct. 4 79°.2
1859 ...	Oct. 4 81°.0	1886 ...	Oct. 5 77°.0
1861 ...	Oct. 8 75°.6	1895 ...	Oct. 1 75°.8
1873 ...	Oct. 3 75°.1	1901 ...	Oct. 1 75°.3
1886 ...	Oct. 1 77°.7		

The warm weather, which continued till October 15, was not confined to London, but extended to all parts of the British Isles. The following figures, extracted from the "Weekly Weather Report," show the mean temperature and its excess above the average for the two weeks ending October 3 and 10.

Districts.	Week ending—Oct. 3. Mean.	Excess.	Week ending—Oct. 10. Mean.	Excess.
	°	°	°	°
Scotland, N.	57.4	+ 9.3	55.0	+ 8.3
,, E.	58.4	+ 9.9	56.1	+ 9.2
England, N.E. ...	61.9	+ 11.5	56.7	+ 7.9
,, E.	61.4	+ 9.9	57.0	+ 7.2
,, Midlands	61.7	+ 11.4	55.9	+ 7.3
,, S.E. ...	61.9	+ 9.0	58.2	+ 7.1
Scotland, W.	59.3	+ 9.4	57.5	+ 9.2
England, N.W. ...	62.7	+ 11.6	57.7	+ 8.1
,, S.W. ...	61.5	+ 9.1	58.4	+ 7.5
Ireland, N.	59.2	+ 8.9	57.5	+ 8.8
,, S.	60.3	+ 8.7	58.5	+ 8.4
English Channel ...	62.8	+ 7.1	60.9	+ 6.6

Is Our Climate Changing?

At the recent meeting of the British Association Sir John W. Moore, M.D., read a paper before Section A on "Is our Climate Changing?" his object being to test the accuracy of the popular opinion that "the seasons have changed." He referred to numerous journals and records of the weather, from that kept by the Rev. William Merle at Driby, Lincolnshire, in the years 1337 to 1344, down to his own records kept at Dublin from 1861 to the present year. He quoted numerous extracts from the past, which showed that the weather experienced then was much the same as it is at the present day.

Sir John W. Moore concluded by saying: "I venture to submit that the facts which I have put forward in this paper prove that, within the past six centuries at all events, no appreciable change has taken place in the climate of the British Isles. There is not a scintilla of evidence to show that—within historic times—any such change has taken place in the past, or is likely to take place in the future."

Prize Competition of the German Meteorological Society.

Dr. Hellmann, the President, announces that the German Meteorological Society proposes offering a prize of 3,000 marks (£150), for the best discussion of the meteorological observations obtained in the international kite and balloon ascents so far as these are published. The conditions are:

1. The judges shall be free to divide the prize.
2. Persons of any nationality may take part in the competition.
3. The manuscripts may be in German, English, or French, and must be legibly written on one side of the paper; and they must also bear a motto. They must be accompanied by a sealed envelope, bearing on the out-

side the same motto, and containing inside the name and address of the sender.

4. The latest date for sending in is December 31, 1911, and the manuscripts should be forwarded to Dr. G. Hellmann, 6, Schinkelplatz, Berlin, W., 56.

5. The results of the competition as determined by five judges will be published in 1912 in the *Meteorologische Zeitschrift*.

Meteorological Instruments.

We have received from Messrs. C. F. Casella and Co., a copy of their new catalogue of "Meteorological Instruments" (120 pages). This is neatly got up and is fully illustrated. The instruments included in this list are barometers, hypsometers, thermometers, hygrometers, evaporimeters, rain-gauges, sunshine-recorders, ozonometers, nephoscopes, balloons and kites for the investigation of the upper atmosphere, electrometers, magnetometers, seismographs, tide-gauges, and compasses. Separate catalogues have already been issued for anemometers and for self-recording instruments, so these are not referred to in the present list. Several new instruments of ingenious design, as well as various improvements in details of construction among the older well-known types, are fully set forth.

Messrs. C. F. Casella and Co. are held in repute for the manufacture of high-class standard instruments, and this new catalogue shows that they are maintaining that reputation.

ORNITHOLOGY.

By W. P. PYCRAFT, F.L.S., F.Z.S., M.B.O.U., &c.

Starlings v. Woodpeckers.

THAT the starling has enormously increased in numbers in Great Britain during the last few years is a well-established fact, and many observers have noticed that this increase has reacted upon the woodpeckers, which are now commonly ejected by the starlings from the holes which they have prepared for nesting purposes. While many contend that in this way the numbers of woodpeckers are in great danger of serious reduction, others hold that it has resulted merely in deferring the nesting of these birds until after the starlings' have finished.

Miss E. L. Turner contributes a perfectly delightful article to the October issue of *British Birds*, describing a contest between a pair of starlings and a pair of woodpeckers for the possession of a hole which the latter birds had selected as a nursery; and we commend the perusal of this to all readers of "KNOWLEDGE" who are interested in first-hand evidence on the question of interspecific selection.

Glossy Ibis at the Land's End.

To the *Field* (October 24), Mr. H. Welch sends a record of the fact that "a fine specimen of the Glossy Ibis was lately shot near the Land's End."

Two-barred Cross-bill in Sussex.

Mr. J. B. Nichols, in *British Birds* for October, records the fact that a fine pair of Two-barred Cross-bills (*Loxia bifasciata*) were shot together at Penhurst, near Ashburnham, Sussex, on March 10, 1908—the cock in fine red plumage, the hen in yellow.

Killdeer Plover in Kent.

Three examples of the Killdeer Plover (*Ægialitis vocifera*), according to Mr. N. F. Ticehurst, in *British Birds* (October), were shot on April 21 and 22 on one of the "fleets" in Romney Marsh, near Lydd. This makes the first record of this American species for Kent, and brings up the total number of occurrences in Great Britain to six.

Black-Headed Wagtail in Kent.

Mr. J. B. Nichols writes to *British Birds* for October to say that a Black-headed Wagtail (*Motacilla flava melanocephala*) was shot at Fairfield, Lydd, Kent, on June 3, 1908.

PHYSICS.

By PROFESSOR A. W. PORTER, B.Sc.

The Amount of Radium Emanation in the Atmosphere.

THIS amount has been recently determined by two observers. Mr. J. Satterly has measured it near the earth's surface at Cambridge, by absorption by charcoal, and also by condensation by liquid air. The two methods give results in fairly close agreement; but show that the amount is not constant. The average value per cubic metre of air is the quantity which would be in radioactive equilibrium with about 10^{-19} grams of radium. This amount (together with its disintegration products) would produce about 3 ions per cubic centimetre per second. As the number of ions actually produced per cubic centimetre per second is about ten times this, Mr. Satterly infers that only a small proportion of the natural ionisation of the air is due to the presence of radium emanation and its products. Professor A. S. Eve has also determined this quantity. His result for the neighbourhood of Montreal is $.6 \times 10^{-19}$ grams as the mass of radium which would be in equilibrium with the average amount of emanation in a cubic metre. The amount, however, was found to vary considerably, the greatest value being about seven times the least. The amounts in summer and in winter are not widely different, and large changes of temperature appear to have little or no direct influence on the quantity. Anticyclonic conditions with dry or very cold weather diminish the amount.—(*Phil. Mag.*, October, 1908.)

The Parent of Radium.

Further experiments by Mr. F. Soddy confirm his original experiment (begun in 1903) in showing the existence of a radium-producing substance in minute amount in commercial uranyl salts. The amount is, in the specimens tested, always below one part in a thousand of the theoretical equilibrium amount which should be present in the natural mineral. The main part by far of the parent of radium in minerals is probably contained in the mother-liquors from the crystallisation of the uranium salts, and so is lost. Reasons are given for supposing that if there is only one long-lived intermediate product between uranium and radium (this specification excludes Ur X) its period of average life must not be less than 16,500 years, or six times that of radium; so that at least six times more of it than of radium must exist in minerals.—(*Phil. Mag.*, October, 1908.)

New Methods of obtaining the Spectra of Flames.

Messrs. G. A. Hemsalech and de Watteville have devised a simple apparatus for the above purpose. A glass bulb encloses a spark gap formed between electrodes of the metal whose spectrum it is desired to obtain. The lower part of the bulb is provided with one or more tubular openings, and the top communicates with a Bunsen burner in such a way that the air feeding the burner flows through the bulb. When powerful electric sparks (condensed) are allowed to pass between the electrodes, metal vapour issues from the latter and diffuses into the surrounding air. This vapour generally combines with the oxygen and nitrogen of the air to form exceedingly small particles, which remain suspended in the air, and are carried along with it into the Bunsen flame, where they give rise to the characteristic flame spectrum of the element under examination.—(British Association, Dublin.)

Heat Evolved by Pitch-blende.

Mr. Horace H. Poole has recently determined this heat by means of a delicate thermocouple. With 560.7 grams. of pitch-blende in an atmosphere of nitrogen, the temperature steadied at .0092° C. above the surroundings. This corresponds to a heat leakage of .053 calorie per hour. Hence the amount per gram per hour is .000094 calories. The amount expected from the radium present is about half of this.—(British Association, Dublin.)

XUM

ZOOLOGY.

By R. LYDEKKER.

The Immortality of Animals.

A BOOK I am fond of reading before going to sleep is the "Recreations of a Country Parson," and therein I happened to come across a passage in which the author expresses his confident belief that man is alone immortal. This was, of course, written in pre-Darwinian days, but it directed my thoughts to the subject, and led me—on the assumption that evolution is the true explanation of the riddle of Nature—to an exactly opposite conclusion. It is now, I believe, generally admitted that the mind of man is but an ultra development of the so-called instinct of animals, and if that be so, it seems difficult to believe that the only essential difference between man and animals is that the former is immortal, while the latter are mortal. But if we consider the matter a little more fully we shall find ourselves in a curious dilemma with regard to this point. For if animals be mortal, there must surely have been a time (always, of course, assuming the truth of the evolution theory) when a man-like ape gave birth to immortal children, while its own "soul" was mortal. Surely, as Euclid would say, this is a *reductio ad absurdum*, and yet I do not see how we can get away from the *crux*.

Irish Charr.

Mr. Regan, of the British Museum, has recently been devoting himself to the study of the charr inhabiting the lakes of Ireland, and, as the result of a careful examination of a considerable series of specimens, is able to announce the existence (or, rather, in certain instances the former existence) of several local varieties, or, as he prefers to call them, species of these interesting fishes. Charr, as the author mentions at the commencement of his article, are typically an Arctic group of fishes with the general habits of salmon; that is to say, they spend the summer in the ocean, but at the commencement of winter ascend rivers for the purpose of spawning. Even in the high north there are, however, some charr which remain throughout the year in their native lakes, although they could reach the sea if so disposed. Others, on the contrary, live in land-locked lakes, from which they cannot possibly escape, and this condition obtains with all the charr of the British Isles, which are, in the main, restricted to lakes where the water is cold and deep. By fishermen charr are often termed "freshwater herrings" or "whiting," from their generally brilliant silvery appearance. Two of the Irish varieties, namely, one formerly inhabiting the lakes at the source of the River Lee, in County Cork, and another Lough Neagh, have been long extinct, the former since 1837, and the latter since 1839. Five others still survive, namely, the Lough Owel charr, of Westmeath, the charr of Lough Finn, Donegal, those of Lough Esk, Donegal, and certain other lakes in Donegal, Mayo, and Galway, and the races respectively inhabiting Lough Melvin, Fermanagh, Lough Cumasaharn, Kerry, and Lough Luggala, Wicklow. These varieties differ from one another in the shape of the muzzle, the size of the teeth, and the number of rows of scales.

The Extermination of the Sturgeon.

In the early days of American history the coasts, rivers, and lakes absolutely swarmed with sturgeon, which were frequently caught, stacked in heaps on the bank or beach, and left to rot, for the reason that they did much damage to the nets of the fishermen. Because they were eaten by the negroes, white men would not touch their flesh in the old days. Soon, however, the heavy rise in the price of caviare in the European market caused the establishment of sturgeon fisheries on the American coasts and rivers, and later on in the lakes of the Mississippi (where a peculiar species is found), and in the course of a few years enormous quantities of these huge fishes were taken and vast profits made. Now the cry is that the fisheries are well nigh exhausted, and in a few years will have to be abandoned. Experiments have, indeed, been made in artificial sturgeon-hatching, but hitherto without success.

The Pigmy Hippopotamus.

As I have had occasion to mention elsewhere, I have been much interested in accounts of the habits of the pigmy hippopotamus of Liberia and Sierra Leone which have recently been sent to this country by a military officer. They confirm previous statements as to these diminutive creatures being more like pigs than ordinary hippos. in their habits, a wallow in a mud-hole being quite sufficient to satisfy their craving for a bath. It is stated, however, by this observer that in place of going about in pairs, as was formerly supposed to be the case, these animals are, for the most part, solitary; instances where two are seen in company being mostly due to a calf accompanying its female parent. The pigmy hippopotamus is specially interesting on account of the fact that closely allied species formerly inhabited Malta and several of the other Mediterranean islands, in company with dwarf African elephants.

REVIEWS OF BOOKS.

BOTANY.

Life Histories of Common Plants, by F. Cavers. D.Sc. (London: University Tutorial Press, 1908; 3s.).—Judging from the style adopted in Dr. Cavers' previous books, we expected to find something much above the average of little books on a botanical theme, and we are not disappointed. The author has had considerable experience in teaching, and obviously benefits by his experience. The old-time methods of commencing with trivial terms, etc., are discarded, and in their place the student is from the first led to look upon a plant as something possessed of life, and by degrees introduced to the various factors upon which the continuance of life depends, not only as regards an individual favoured by special circumstances, but also in the great struggle for existence which every plant in a state of nature has to contend with. The author insists on practical work, close observation, notes and sketches bearing on phenomena observed, and leaves the student to work out for himself the various problems, being content to point out and correct mistakes rather than to tell the student what he should see and observe. This is as it should be, as it is a well-known fact that a beginner can generally manage to see whatever may be prompted. The numerous figures are clear and well selected, and a series of questions at the end of each chapter offer an opportunity of testing whether the most important points discussed have been clearly grasped.

EVOLUTION.

Heredity, by J. Arthur Thomson (London: Murray, 1908; Progressive Science Series; 9s. net).—One of the most subtle and difficult of analysis of all the problems which confront the biologist is the riddle of Heredity—that intangible property of pullulation peculiar to living matter. And with this property is inseparably united another, which we call inheritance. Hereby more, or fewer, of the characters of the parent are transferred to the offspring; more correctly, perhaps, the heritable material is passed on from one generation of germs to another, how much of that material is carried in each germ is manifested, more or less patently, in the soma to which each germ gives rise. Only within the last few years has any real progress in this study been made, but during this time an appalling amount of literature has sprung up, not all of which has been worthy of the theme. Professor Thomson has set himself the task of analysing this output, and that he has been singularly successful in winnowing the wheat from the chaff is beyond dispute. The results of his labours are now presented to the world in a volume which may be regarded as the standard work of reference on this subject. To the biologist it will prove indispensable; while to the student of sociology, and to the medical man, it will probably come as a revelation, for it must be admitted that neither of these last have shown any grasp of the significance of what is meant by Heredity, certain exceptions apart. As a judicial summary of an exceedingly difficult and controversial subject it is masterly, while in the matter of clearness of exposition it has no rival. In the space at our disposal anything like an exhaustive account of the contents of this book is

impossible. It must suffice to point out one or two of the more important chapters from the point of view of the general reader. The chapters on the Transmission of Acquired Characters, on Heredity and Disease, and on the Relations between Biology and Sociology, for example, will be read with profit even by those who have no special training in biology. Much that they contain should be more widely known than is the case at present by those who are dabbling in the science of eugenics and social problems. We notice one omission, however, from these pages—there is no detailed account of "Opsonins" and the relation thereof to the resistance of disease. The word "Opsonic Index" indeed occurs, but only once in these pages, and no explanation of the term, or its importance, is given. Yet one might well have expected that some account of this latest discovery would have been given. This omission, however, cannot be called a very serious one, having regard to the scope of this book, and it can well be amended in a future edition, which is almost certain to be demanded. Professor Thomson has exercised in the preparation of this book a rare discrimination, and has shown a fine grasp of a most complicated subject. In marshalling his facts he has displayed an amazing skill, for he has placed the most abstruse facts in a light so strong and clear that any possible shadows of misconception are effectually dispelled. He has swept within his net all that has been said on this most difficult theme, and thereby has laid us all under a debt of gratitude. And the truth of this estimate will soon be obvious to those who read this book.

MATHEMATICS.

An Introduction to the Theory of Infinite Series, by T. J. I'A. Bromwich, F.R.S. (London: Macmillan and Co., 1908; price 15s. net).—Infinite series are dangerous tools to place in the hands of the mathematical novice. In the olden times they were freely used in examinations at Cambridge in which the candidates were allowed to use neither the calculus nor the methods of analytical geometry. Nowadays, practical requirements, if not also considerations of an educational character, have moved the study of the elements of the calculus many places forward in our curricula. Professor Bromwich, in his preface, remarks, "I have for some time been convinced that beginners should not attempt to study infinite series in any detail until they have mastered the differentiation and integration of the simpler functions, and the geometrical meaning of these operations." With this authoritative statement we most emphatically agree. At the same time there is scarcely a single problem in mathematics, pure or applied, the arithmetical solution of which can be reached by a finite number of operations, and it follows that no student can consider his mathematical training satisfactory from the most practical and utilitarian point of view who does not know something about the uses and abuses of infinite series. The practical man must not forget that but for the use of infinite series as approximations to the values of transcendental functions, mathematicians would have been to this day running their heads against the blank wall which barred all further progress to the old circle squarers. The present book certainly is a great deal more than an elementary text-book. It contains a detailed treatment of recent developments of the theory of infinite series. We may instance Pringsheim's theory of double series, and the chapter on non-convergent and asymptotic series, in which reference is given to the conclusions obtained by Borel and others. A certain amount of long algebra is necessarily associated with the present subject, but the author has been very successful in keeping formidable expressions and formulæ within as narrow limits as could reasonably be expected. He also appeals to graphic methods wherever possible. Many theorems which are of the nature of special applications have been inserted in the form of examples accompanied by references to the authors. We are glad to see the appendix dealing with the theory of the logarithm defined as the integral of the reciprocal or the area of a hyperbola. The author points out in his preface that "the use of this definition of a logarithm goes back to Napier, but in modern teaching its advantages have been overlooked until quite recently." The method of treating logarithms that has thus sprung up has been very unsatisfactory, and as this is a matter which affects other workers in science than the mathematician, we refer a little more fully to it here. The plan which is still usual consists in postponing the study of logarithms until a lot of drudgery has been gone through on fractional and negative indices. A logarithm is then defined by means of indices and the index properties merely translated into properties of logarithms. This order is not only historically incorrect, but it keeps the practical uses of the study in the background. A further mistake is made when the beginner is led to believe that mathematicians for no other reason than mere perversity chose an incommensurable number e as the base of these logarithms. Now e was never thought of when logarithms were invented, and it would never have been chosen if Napier had started from the notion of a *base*. The proper way of teaching logarithms is to assume the existence of a system of functions defined by the property

$$\log m + \log n = \log mn,$$

which involves no more assumptions than the corresponding index property usually assumed; moreover, an easy illustration is afforded by the slide rule. Now, if one such system exist, any number of other systems can be obtained by multiplying the logarithms of the first system by different constant factors. If we choose the constant factor such as to make the logarithm of any number equal to unity, that number is defined as the base of the system. In illustration, the measurements of the readings on the slide rule depend on the unit of measurement, and the slide rule reading of the unit of measurement is defined as the corresponding base. In conclusion it is evident that a large amount of time and thought has been spent on writing this book, and we hope that the author will find the task has been less thankless than is usually the case in bringing out an English treatise on any branch of higher mathematics.

As a postscript to this notice we would call attention to the use of the suggestive Continental notation arc sin and arc cos, which is far more intelligible than the misleading negative index commonly used. It is difficult even for an experienced mathematician to fully realise that the latter symbol really represents an angle, and certainly very few students, if any, do so.

PHYSICS.

Introduction to Metallography, by Paul Goerens, translated by F. Ibbotson (London: Longmans Green, 1908; 7s. 6d. net).—There has long been a necessity for a thorough work in English upon this subject, which the present volume very adequately satisfies. An immense amount of light has been thrown upon the structure of metals by recent research in physical chemistry and in microscopy. There is a very close analogy between the crystallisation of a salt from an aqueous solution and the solidification of mixed metals. All the phenomena attending such solidification are very fully studied here. Then follow very practical directions in connection with the microscopic examination of metals; modes of preparing sections, polishing, etching, and illuminating them. There are a number of reproductions of photomicrographs illustrating the structure of different varieties of iron. Altogether the subject is a most fascinating one, and is very successfully treated.

Nephilim, by W. J. H. Bohannan (New York: Reeve A. Silk, 1908; $1.50).—This book is written to show the error of "science" and to point out the truth of statements of the Bible concerning physical phenomena. The author's quarrel is with the Newtonian theory of gravitation, and, in common with many others, his first difficulty is with the tides. We regret that we simply do not understand his objection, and we equally perceive that he does not understand the scientific explanation. As to the claim of this book on the readers of "KNOWLEDGE," the following quotation must suffice:—"There is not a whit of difference between the fall in Eden and the gravitation of Cambridge. All the world over, falling apples; then falling woman, falling man, all wrapped by the coil of the fallen angel under the law of falling bodies." There may be some who can appreciate this kind of thing; we modestly admit our inability. As regards the mysterious title, the intimation appears to be that just as the race of giants (Nephilim) was destroyed in the Flood, so "a flood of intellectual giants, a downfall of stargazers, monthly prognosticators, and high-soaring philosophers is an occurrence inevitably bound to happen." The evidence is somewhat slight.

XUM

MICROSCOPY

Conducted by F. SHILLINGTON SCALES, B.A., F.R.M.S.

Preparation of Microscopical Objects.

(*Continued from page* 244.)

BEFORE proceeding to deal with individual stains in detail it may be advisable to mention certain precautions which must be attended to in order that good and uniform results may be obtained.

α Formulæ will be given for the preparation of each stain, and these must be carefully followed. The stains must be well filtered before being bottled, and in most cases it is advisable to filter them again just before use, in order to get rid of crystalline products, dust, hairs, etc. A very convenient way of doing the latter is to make of fairly stout wire a small ring about the size of a two-shilling piece, to twist the ends together and bend them at almost right angles to the ring, to carry the twist down for about an inch and a quarter, and then, bending the wire once more, to form with its two ends a rather larger ring immediately beneath the other ring, to serve as a stand. A circular piece of filter-paper, folded into four, is then inserted in the usual way into the upper ring, and through this the stain is filtered direct as required. The portability and size of this little filter stand make it very convenient for filtering stains direct on to the cover-glass or slide in requisite quantity and without splashing. With regard to the keeping of stains it must be borne in mind that some stains, such as haematoxylin, are all the better for being kept, whilst others deteriorate, and some may decompose or even putrify. The latter can generally be obviated by adding a crystal of thymol or a little salicylic acid.

β The staining powers of a stain may be increased by using a stronger solution, by allowing it to act for a longer time, by warming the stain, or by adding certain other substances to it, *e.g.*, aniline oil.

γ It is a mistake to use too small an amount of stain. There should always be ample to cover the object thoroughly, and often more than this is requisite.

In the selection of the stains which follow I have adopted no principle other than that of general usefulness and comparative ease of application, and I begin with those most generally known. It must be remembered that they are given as examples only, and that no attempt is made to provide anything like an exhaustive list.

Let us take first, though it is less used now than formerly, CARMINE. This is a bright red stain made from the bodies of the cochineal insects. Its active principle is carminic acid. It is most used for *general* staining of entire objects, or of tissues *in bulk* before section cutting, and for vegetable sections. It is of wide application and easy to use, and the choice of fixing agent is not of importance. There are many formulæ, but Mr. Lee recommends for beginners *Grenacher's alcoholic borax-carmine*, *carmalum*, or *alum-carmine*, and as I do not think this selection can be improved upon, I will give these three as examples :—

Grenacher's Alcoholic Borax Carmine.—This is the best solution for vegetable sections and for staining in bulk. Dissolve 1 grain of carmine in 100 cc. of 4 per cent. borax solution by heating for half-an-hour or until the carmine dissolves, add an equal volume of 70 per cent. alcohol, allow to stand for 24 hours, and filter. Tissues must remain in this stain until thoroughly penetrated, a process which may take some days, and then transferred, without washing, into 70 per cent. alcohol, acidulated with a few drops of hydrochloric acid per 100 cc. and left there until they are differentiated, a process generally taking also a considerable time, at the end of which they will have acquired a more or less transparent appearance. The time required is one of the drawbacks to the use of the stain, and it will be found to be somewhat erratic in both its staining and penetrating properties on different tissues. On the other hand, the stain is a permanent one. Overstaining may be rectified by means of a weak solution of hydrochloric acid, varying from 0.1 to 1.0 per cent., but this has a tendency to precipitate the carmine. Dehydrate with 98 per cent. alcohol, clear, and mount in Canada balsam.

Mayer's Carmalum.—Dissolve 1 grain of carminic acid and 10 grains of alum in 200 cc. of distilled water, with heat. Allow to cool. Filter. Add a few crystals of thymol or 0.1 per cent. salicylic acid as preservative. This stain penetrates tissues in bulk very well, but the process may take anything from a quarter of an hour to several hours. Washing must be done thoroughly in water only if a general plasmatic stain is required, whilst washing with very dilute acid or alum solution will tend to differentiate nuclei. The acid must be thoroughly washed out. Dehydrate gradually with alcohol of increasing strengths—30, 50, 75, and 98 per cent.—clear, and mount in Canada balsam. Carmalum cannot be used as a stain with tissues which are alkaline.

Grenacher's Alum Carmine.—Both this and the previous stain can be used more particularly for the nervous system. Add ½ to 1 grain of carmine to a 1 to 5 per cent. solution of common alum in 100 cc. of water. Boil for about a quarter of an hour, cool, and filter. It is a very useful stain for general purposes as it does not easily overstain, but it does not penetrate well, and is, therefore, less suitable for staining objects in bulk. It has a selective action on nuclei, but must not be used for calcareous structures.

Picro-carmine.—This is a stain that is less popular now than it used to be. It was formerly supposed to be an ammonia picro-carminate, but has been shown by Mayer to be an uncombined mixture of carmine, ammonia, picric acid, and other substances in variable and indefinite proportions. As Mr. Lee points out, its *raison d'être* does not lie in its capacity for double staining, as equal or better results can be obtained by staining first with borax carmine and then after-staining with picric acid, but in the combined stain the picric acid is supposed to neutralise the ammonia. Picro carmine is, however, useful for fresh tissues, owing to the fixing power of the picric acid. Picric acid stains fibrous tissues and keratin yellow, and acts very rapidly upon them. Bourne's formula for picro-carmine is as follows :—Add 5 cc. of ammonia to 2 grains of carmine in a bottle that will hold about 250 cc. Stopper, shake, and put aside until next day. Then add slowly, shaking meanwhile, 200 cc. of a saturated solution of picric acid in distilled water. Put aside for another day. Then filter, add 4 drops of ammonia, and return to the stoppered bottle. Sections stained in picro-carmine must not be transferred to water, but should be washed in alcohol of not less than 70 per cent. strength, or the surplus stain may be removed by filter-paper and the section mounted in glycerine, or, for a permanent preparation, in Farrant's solution. The staining may take

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5 or 10 minutes or more, and may be hastened by warming the solution. The small amount of stain left in the sections when mounted in glycerine continues to act, and the staining of the section is often much improved after two or three days and after exposure to daylight. A section of skin stained by this method gives very striking results. (*To be continued.*)

Meteorological Uses of the Polariscope.

In the Proceedings of the American Academy of Arts and Sciences, XLIII., 1908 (J.R.M.S., 1908, p. 374), Mr. L. Bell gives the result of some observations made by him at Mount Moosilanke, New Hampshire, which indicate that the polariscope may possibly be of service in forecasting the weather, as the spectroscope has already proved to be. The air is never free from suspended particles of some kind, and these particles are the cause of haze. This haze produces polarization similar to the well-known sky-polarization, though the particles are much smaller than the wavelength of light. The polariscope integrates the effects of such particles along the line of sight. The process of increasing nucleation, which results in cloud formation, and frequently in subsequent rain, was found to be accompanied by a fall in polarization, and its progress could be well followed by the polariscope.

Colour Photography in Metallography.

In a French paper, *Metallurgie*, V., 1908 (J.R.M.S., 1908, p. 395), M. P. Goerens describes the production of colour photo-micrographs of the colours in heat-tinted metal sections. Etching methods merely bring out the various constituents of the steel, etc., in relief, and M. Goerens considers that heat-tinting is too little used. He used Lumière plates and reproduces coloured photo-micrographs of a heat-tinted phosphorus alloy, which show clearly the variation in concentration of the solid solution. The theory of the process and full instructions for working it are given. M. Goerens says it is advisable to use a yellow screen, and to have the sections as markedly coloured as possible.

Quekett Microscopical Club.

October 2.—The Hon. Secretary referred to the loss the Club had sustained in the death of the late Mr. F. H. Wenham, C.E.

Mr. T. A. O'Donohoe exhibited and described some photomicrographs of *Podura* scale × 2,000 taken with condenser cones of different values, ranging from 0.35 to 0.65. He was convinced that a small cone gave an altogether wrong impression.

Mr. C. F. Rousselet, F.R.M.S., described a new species of rotifer from Boston, U.S.A., *Notholca bostoniensis*, sp. nov., which he had taken in August, 1907. A preparation of the new species was exhibited.

Mr. T. B. Rosseter, F.R.M.S., read an interesting paper on the family Tæniidæ. In 1869 the Danish helminthologist, Krabbe, published a description of 123 species with 313 figures, and in 1882 added 42 more species and gave 67 further figures. The work of Mequin and Moniez and many other observers since von Linstow, in 1872, was referred to. Some account of the speaker's own work, particularly on the genus Hymenolepis, was followed by the methods employed in obtaining, preparing, and mounting the specimens examined.

Microscopical Material.

Mr. W. E. Harvey has very kindly sent me for distribution some Foraminiferal gatherings from the English Channel. I shall be pleased to send some of these to any reader who cares to apply. All applications must be accompanied by a stamped addressed envelope, and by the coupon to be found in the advertisement columns of this issue of "KNOWLEDGE."

Notes and Queries.

T. H. G. Harda (India).—I do not know of any means of getting specimens named, other than by bringing them under the notice of authorities on the particular group required, and now-a-days the field of science is so extensive that a specialist generally confines himself to a comparatively limited subject. Specialists, generally speaking, are very ready to assist in the naming of any specimen of real interest, if sent by a man who is really working at the subject, but it is not fair to take up the valuable time of men who are engaged in original work by asking them to name specimens which are probably neither unusual nor specially interesting, and which are sent by men who are not studying any particular branch of natural history, but are, perhaps, merely curious as to the exact name of some object which has come under their notice. It is for this reason that I have had to request readers not to send me specimens to be named, as I found I was constantly taking up my own time or, what is even worse, that of my friends in and out of Cambridge, in getting specimens named that were sent to me with no ulterior object by correspondents who did not at all realise the nature of the gratuitous service rendered. None the less, I am glad at all times to assist real workers in this, as in any other way, and if you have any definite need for help I shall be glad to assist you. I am afraid I have never even heard of the "Institute" you mention, nor do I think you would be successful in forming a corresponding microscopical society, as serious workers, who would alone be able to give valuable service, are too busy to give assistance to such a society. I would suggest your writing to the Secretary of the Quekett Microscopical Club (Mr. W. B. Stokes, 4, Winn Road, Burnt Ash Hill, Lee, London), asking him if the Club admits corresponding members, telling him what branch of study you are most interested in, and enquiring if he knows of any member who is interested in your subject and who would be good enough to assist you in naming your specimens. The Club exists mainly for mutual help amongst its members, and there is much good fellowship amongst them. The subscription is only 10s. 6d. per annum, and includes a copy of the interesting Journal published twice a year. I have answered your question at length, hoping that other workers abroad, of whom there must be many who are readers of this Journal, if I may judge by the correspondence I receive, may find the suggestion of service.

Adhesive for Minute Objects.—A correspondent will be grateful for information as to a suitable adhesive to keep in place the minute mouth parts of the gnat and flea when dissected. Gum tragacanth has been tried, but it shows badly through the Canada balsam, and when not attached to the slip the objects tend to float about. I presume that mounting upon the cover-glass with a minimum of Canada balsam before mounting on the slip has already been tried.

Microscopical Material. J. S. (Swatow, China).—I shall be very glad of any microscopical material you can send me for distribution. Foreign material is always interesting to English microscopists. Perhaps some other readers abroad will also be good enough to help in this way. I have been able to distribute quite a lot of material during the past year, which seems to have been generally appreciated, and not a little of it has gone abroad. The distribution certainly gives me a good deal of trouble, but that is a minor matter!

Second-hand Instruments.—Mr. C. Baker, of 244, High Holborn, has sent me his autumn list of second-hand microscopes and accessories, telescopes, and optical and scientific instruments generally. The catalogue contains nearly 60 pages, and is a model of classification. I would recommend any reader who is thinking of making a second-hand purchase to write for a copy.

[Communications and inquiries on Microscopical matters should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge. Correspondents are requested not to send specimens to be named.]

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The Face of the Sky for November.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 6.56 and sets at 4.32; on the 30th he rises at 7.44 and sets at 3.53.

Sunspots have lately been fairly conspicuous. The equation of time is a maximum on the 3rd, the sun being 16m. 20s. in advance of the clock.

The positions of the Sun's axis, centre of the disc, and heliographic longitude of the centre are given in the following table:—

Date.	Axis inclined from N. point.	Centre N. of Sun's Equator.	Heliographic Longitude of Centre of Disc.
Nov. 1 ..	24° 36′E	4° 14′	293° 30′
,, 6 ..	23° 39′	3° 43′	227° 34′
,, 11 ..	22° 31′	3° 9′	161° 40′
,, 16 ..	21° 10′	2° 34′	95° 44′
,, 21 ..	19° 39′	1° 58′	29° 50′
,, 26 ..	17° 57′	1° 20′	323° 56′
Dec. 1 ..	16° 5′E	0° 42′	258° 2′

THE MOON:—

Date.	Phases.	H. M.
Nov. 1 ..	☽ First Quarter	2 16 p.m.
,, 8 ..	○ Full Moon	7 58 a.m.
,, 15 ..	☾ Last Quarter	11 41 p.m.
,, 23 ..	● New Moon	9 53 p.m.
,, 30 ..	☽ First Quarter	9 44 p.m.
Nov. 5 ..	Perigee	0 42 a.m.
,, 16 ..	Apogee	9 30 p.m.
,, 30 ..	Perigee	3 12 p.m.

OCCULTATIONS.—The following are the principal occultations visible from Greenwich:—

Date.	Star's Name.	Magnitude.	Disappearance.		Reappearance.	
			Mean Time.	Angle from N. point.	Mean Time.	Angle from N. point.
			p. m.		p. m.	
Nov. 1	χ Capricorni	5·3	8.19	96°	9 20	222°
					a.m.	
,, 4	30 Piscium	4·7	11.16	56°	0.21	243°
					p.m.	
,, 9	ε Tauri	3·7	8.16	92°	9.14	225°
,, 10	ο Tauri	4·8	9 45	120°	10 29	207°
,, 30	τ^1 Aquarii	5·6	7 43	121°	8.18	182°
,, 30	τ^2 Aquarii	4·3	8 46	71°	9.50	232°

THE PLANETS.—Mercury (Nov. 1, R.A. 13h 54m; Dec. S. 11° 6′. Nov. 30, R.A. 15h 31m; Dec. S. 18° 9′) is a morning star in Virgo and Libra. The planet is at greatest Westerly elongation of 19° 18′ on the 13th, when he rises at 5.18 a.m., or two hours before the Sun.

Venus (Nov. 1, R.A. 11h 54m; Dec. N. 2° 12′. Nov. 30, R.A. 14h 4m; Dec. S. 10° 31′) is a morning star in Virgo, rising at 2.57 a.m. on the 1st and at 4.17 a.m. on the 30th. The duration of visibility is becoming less, but at the end of the month she is a conspicuous object in the morning sky, rising three hours in advance of the Sun. The apparent diameter of the planet is 14″, and three-fourths of the disc is illuminated.

Mars (Nov. 1, R.A. 12h 54m; Dec. S. 4° 49′. Nov. 30, R.A. 14h 5m; Dec. S. 11° 53′) is a morning star in Virgo, rising at 4.30 a.m. on the 15th, on which date he is about 2° North of Spica. The apparent diameter of the planet is 4″, and hence he appears as but a feeble object.

Jupiter (Nov. 1, R.A. 10h 46m; Dec. N. 8° 53′. Nov. 30, R.A. 10h 59m; Dec. N. 7° 36′) is a conspicuous object in the morning sky looking E. The planet rises on the 1st at 1.15 a.m. and on the 30th at 11.39 p.m. In consequence of diminished declination, he appears lower in the sky than in the earlier part of the year, but still remains in a good position for observation. The equatorial diameter of the planet is 34″, whilst the polar diameter is 2″ smaller.

Saturn (Nov. 1, R.A. 0h 20′; Dec. S. 0° 39′. Nov. 30, R.A. 0h 17m; Dec. S. 0° 59′) is very favourably placed for observation, being due South on the 1st at 9.37 p.m. and at 7.40 p.m. on the 30th. The planet is situated in Pisces, a few degrees below the great square of Pegasus, and is readily detected by his peculiar leaden lustre. The apparent diameter of the outer major and minor axes of the ring system are respectively 44″ and 4″, and we are looking on the Southern surface at an angle of 5°, so that the ring appears slightly open, though it requires a power of about 100 to detect this. The diameter of the ball is 17″.

Uranus (Nov. 15, R.A. 19h 2m; Dec. S. 23° 6′) is unfavourably placed for observation on account of his great Southerly declination; the planet is situated about 2° South of the star ξ^2 Sagittarii and near the middle of the month sets at 7 p.m.

Neptune (Nov. 15, R.A. 7h 13m; Dec. N. 21° 36′) rises shortly after 7 p.m. and crosses the meridian at 3.34 a.m. on the 15th. The planet is situated about half a degree South of the star δ Geminorum.

Comet (Morehouse, 1908 c) was discovered on September 1 and will probably be visible to the naked eye during the month. The date of perihelion or nearest approach to the Sun is December 24, when it will be within the earth's orbit at about 0·92 the earth's distance; before this date, however, it will be lost in the Sun's rays but should be observable until early December. Observing at the end of September I readily found the comet with a pair of ordinary field glasses (prismatic glasses are unsuitable on account of loss of light) when it appeared as a nebulous mass with but little tail and was just visible to the naked eye; nearly a fortnight later the comet was easily found with field glasses but apparently had not increased in brightness though the tail was now very distinct with indications of a second shorter tail. A series of photographs has been obtained at Greenwich which show a tail of some degrees in length with several subordinate tails. The comet passes between the principal stars of Cygnus and Lyra and in November will be situated in the western portion of the sky; its exact position is given in another column.

METEORS.—The principal meteor showers during the month are the Leonids and Andromedids:—

Date.	Radiant.		Characteristics.
	R.A.	Dec.	
	h. m.		
Nov. 14-16..	10 0	+22°	Swift, streaks. (*Great Leonid* shower.)
,, 17-23..	1 40	+43°	Very slow, trains. (Great Andromedid shower.)

Algol will be at minimum on the 1st at 5.35 p.m., 18th at 10.38 p.m., 21st at 7.17 p.m., and 24th at 4.6 p.m.

TELESCOPIC OBJECTS:—

DOUBLE STARS.—η Cassiopeiæ 0h 43m, N. 57° 17′, mags. 3½, 7½; separation 5″·9. Binary star.

λ Arietis 1h 52m, N. 23° 6′, mags. 4, 8; separation, 37″. Components white and blue; easy with power 20.

η Persei 2h 44 , N. 55° 28′ mags. 4, 8; separation 28″. The brighter component is orange, the other blue. There are also several other fainter stars very near.

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